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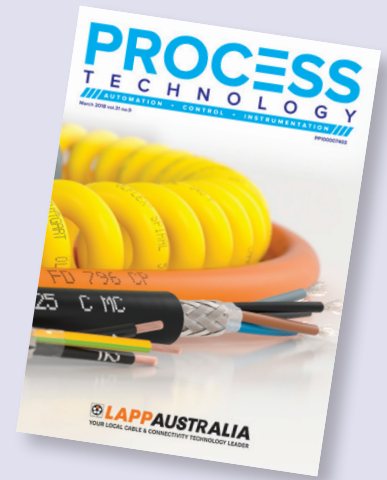
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Lapp Australia's range of Ölflex flexible and oil-resistant connecting and control cables is one of Lapp's most widely used and successful ranges globally. In establishing a new, fully-fledged subsidiary in Australia — open since 1 February — Lapp is seeking to introduce the advantages of the Ölflex range to a broader audience of customers locally. Ölflex cables can be used in an extensive range of industrial machinery and equipment, such as heating and cooling systems, wind power systems, buildings, medical technology, food and beverage technology, construction, vehicles and mobile equipment. The highly durable and flexible Ölflex cables are designed to fulfil the most demanding requirements for electrical and mechanical properties and can feature resistance to flame, oil, chemicals, weather, abrasion and cuts.

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CONNECTIVITY: BACKBONE OF THE DIGITAL ENTERPRISE

PART 1



Bridging the divide between operational technology (OT) and enterprise information technology (IT) in the right way will support collaboration and enhance overall production efficiency, reliability, visibility, flexibility and security.

For decades, the world's many industries have invested heavily in information technology (IT) to reduce costs, improve operational efficiency and visibility and, ultimately, to boost profits. In doing so, IT professionals have laid a big part of the foundation for what's called the 'digital enterprise'. But for extractive, manufacturing and logistics industries, the digital enterprise also involves another form of technology on the 'shop floor' side of an organisation, which is commonly referred to as operational technology (OT).

Over the same decades that gave rise to IT, companies have invested hundreds of billions in OT, much of it for increasingly smart machines and systems to automate discrete production tasks and continuous processes. This includes automation control and higher-level OT management platforms to efficiently operate, monitor and optimise OT performance and maximise the utilisation of capital assets as much as possible. It also includes various industrial communication technologies that keep all these systems talking to each other and to their human operators.

The benefits have been many, including major reductions in costs, latencies and cycle times, as well as fewer data collection errors. Industrial communications — the so-called digital thread — has also helped interconnect what were once islands of activities and information, while also breaking down operational silos. Another benefit is full process transparency where, for example, it is possible to have instant access to quality data or stock levels, be more flexible and reduce reaction time to changing demand. In addition, companies can

achieve vertical integration. This includes benefits such as instant access to service teams via the internet, immediate response to product changes through automated download of new production data from R&D, implementation of the digital twin in engineering and PLM processes, and real-time, global data availability.

Connecting these two worlds — IT and OT — for a truly end-to-end digital enterprise is ideally the role of modern industrial communications that are fast, reliable and secure. Unfortunately, for far too many organisations, sharing data between these two worlds can be a struggle because their network infrastructures could be more up to date and better connected.

Another important reason that makes connecting IT and OT a challenge is this: the perspectives of enterprise IT and OT professionals are typically very different. Although their jobs are interrelated in many ways, each tends to have dissimilar educational and on-the-job backgrounds to the other.

For example, IT staff often come from computer science backgrounds, while OT staff have industrial engineering backgrounds. IT professionals tend to focus on cost optimisation and security, while OT professionals tend to concentrate on production throughput and machinery availability. Both share concerns for productivity and efficiency. These distinct pedigrees can result in sometimes suspicious and occasionally adversarial perspectives toward the work each other does.

It doesn't have to be that way — and indeed it shouldn't be, if organisations are to realise the full promise of an end-to-end



digital enterprise. That's because modern industrial communications can tie the IT and OT sides of the digital enterprise together, while also enabling major transformations in how raw materials are sourced and transported, products are made and finished goods get to market.

It is only through an active IT/OT collaboration based on the mutual understanding of each other's respective roles and backgrounds that data flows can be optimised over a company's networks, the backbone of the digital enterprise. And we know that not all data spanning the digital enterprise is equal: some deserve special treatment, given the specific role particular data may play in a critical process or workflow.

Ultimately, by understanding the full potential of modern industrial communications, IT and OT can work together to ensure more operational efficiency, visibility, flexibility and security in production. This can help companies fully realise the promise of the digital enterprise to gain greater competitiveness and profitability both in the short term today and the long term tomorrow.

Marking the IT/OT divide

Classic corporate IT is a big job, although no more so than OT. Day to day, IT teams must be extremely tactical in support of end-user productivity, identity management, cybersecurity, office networks, and departmental file servers and printers, to name just some of their many day-to-day chores. Hours can be long and demands high.

At the same time, especially in large enterprises, their jobs can also involve the deployment and management of large strategic assets and capabilities — enterprise resource planning (ERP) systems, customer relationship management (CRM) systems, big data analytics and other core applications residing in either data centres or the cloud.

Mission-critical IT

Sophisticated IT often can be core to what many companies do and be the foundation of their customer value propositions, if not their competitive differentiators, as well.

Take FedEx, for example. Back in the 1990s, the company deployed technologies such as wireless handheld scanners for its courier and counter staff supported by giant back-end databases, pioneering self-service package tracking for customers via a web portal. For a time, this capability gave FedEx a big competitive edge, although it's now a standard in the logistics industry. IT was so vital to FedEx that company founder and CEO Frederick W Smith once described his firm as "an IT company that just happens to ship boxes to pay for it all". In fact, the public networks and FedEx's own private networks were critical enablers of that package-tracking functionality.

Hands full with the OT

While IT teams keep their companies' front- and back-office operations running, their OT counterparts have their hands full keeping production running. Disruptions and downtime of components, instrumentation or systems can potentially have not only bottom-line consequences but also cascading downstream impacts on customer delivery commitments and satisfaction.

Life safety can be at stake, too. The Texas City refinery explosion in 2005, for example, killed 15 people and injured more than 100. The cause was found to be the failure of several level indicators, which led to the overfilling of a vapour-liquid separator. As a hydrocarbon geyser erupted, its flow was ignited by the engine of a truck idling nearby.

Many OT professionals are always on call. That's because many industrial facilities — power plants, oil platforms and public communications, to name just three — must operate around the clock, in real or near-real time and with 99.999% uptime or better.

Reliability, durability and availability are of utmost importance. In contrast, most enterprise IT networks must simply work during business hours.

OT teams also need to ensure that a complex, often heterogeneous, technology landscape at the field level — including sensors, actuators, valves, instrumentation and other devices, even conveyors — are all functioning properly, often in harsh operating conditions. At the same time, all these elements feed and draw operational data into and from a dynamic, vertical infrastructure consisting of a wide range of controllers, operator systems and manufacturing execution systems.

In addition, OT solutions used in discrete manufacturing typically must be finely tuned across their operating network structures and constituent components (both hardware and software). Those always-on components must use fixed IP addressing, resulting in different bandwidth cost models compared to enterprise IT networks that typically use dynamically assigned IP addressing.

What's more, cycle timings, usually in milliseconds, and data communications need tight synchronisation across all of those components. This is true regardless of the industry and much more so in critical infrastructures such as power, communications and transportation.

Network differences

OT networks differ from enterprise IT networks, too. Data packet routing between network nodes in the former must operate deterministically compared to the latter's 'best effort' routing. Deterministic means the routing of data packets must be predetermined in advance of their transmission, so the packets and their information payloads get to where they need to go within the cycle times required by a machine or process.

Why? Cyclically executing process programs need constantly updated input data

in order to issue the appropriate control commands to components. Those commands have to arrive when expected, within milliseconds. In other words, a network hiccup that might delay an outbound email by a couple of seconds might not be noticed by a user, but a similar delay in a controller command arriving at its destination could disrupt an entire production line.

Time to bring teams together

To be sure, more and more companies the world over are moving toward greater integration that will help make them truly end-to-end digital enterprises. They're bridging the divide separating IT and OT, in part by purposefully bringing both teams together to facilitate greater understanding and cooperation.

They're also facilitating a vibrant digital thread of data throughout their businesses by modernising their network communications with advanced technologies, while incorporating OT's precision requirements for production networks and data functionality into strategic plans for their overall enterprises.

Aligning perspectives

By aligning the different perspectives of IT and OT functions, these companies are helping to eliminate legacy information islands and silos that can slow down the speed of production and business, limit operational visibility and delay time to market.



BY ALIGNING THE DIFFERENT PERSPECTIVES OF IT AND OT FUNCTIONS ... COMPANIES ARE HELPING TO ELIMINATE LEGACY INFORMATION ISLANDS AND SILOS THAT CAN SLOW DOWN THE SPEED OF PRODUCTION AND BUSINESS, LIMIT OPERATIONAL VISIBILITY AND DELAY TIME TO MARKET

They are leaving data synchronisation and transcoding issues in the past, so they no longer experience time-consuming, error-ridden data handoffs and cycle-time latencies. Quality has risen; rework has dropped. Operational visibility has improved too. And they have gained greater operational flexibility and new business agility that enables them to respond faster to dynamic customer demands and wholly new opportunities.

In short, they're gaining advantages over less innovative competitors, who might be overlooking or ignoring issues spawned by the IT/OT divide.

But for those latter companies taking a wait-and-see attitude toward end-to-end digitalisation and modernising their network communications, competitive disadvantage isn't their only risk of not doing so. They face a wide world of cyber threats — external and internal — just waiting to exploit the vulnerabilities inherent in a fragmented digital landscape.

Obscure vulnerabilities

While industrial networks may appear inside companies as stand-alone, closed-loop systems, often they can be connected at some obscure point to the enterprise network. If so, the latter's external-facing cyber vulnerabilities can then extend to the industrial network.

Another set of security issues with industrial networks involves their evolution from early assortments of electrical relays or antiquated microprocessor controllers and manually monitored indicator lights, trips and breakers. Those legacy systems might work well enough to operate relatively simple processes even today, but they likely lack proper security controls.

For example, these systems may well be connected to modern distributed control systems that feature the latest PLCs. The latter are essentially microcomputers using Windows or Linux and are connected over industrial Ethernet to HMIs. In turn, these HMIs are often accessible remotely via PCs or touch-screen tablets and smartphones — by legitimate operators or by hackers exploiting the vulnerabilities in the connections between old and new systems.

To make matters worse, the integration of the two kinds of networks can also introduce uncertainty within companies as to whether IT or OT owns responsibility for overall cybersecurity. As result, accountability issues can arise, manifesting themselves as cybersecurity gaps.

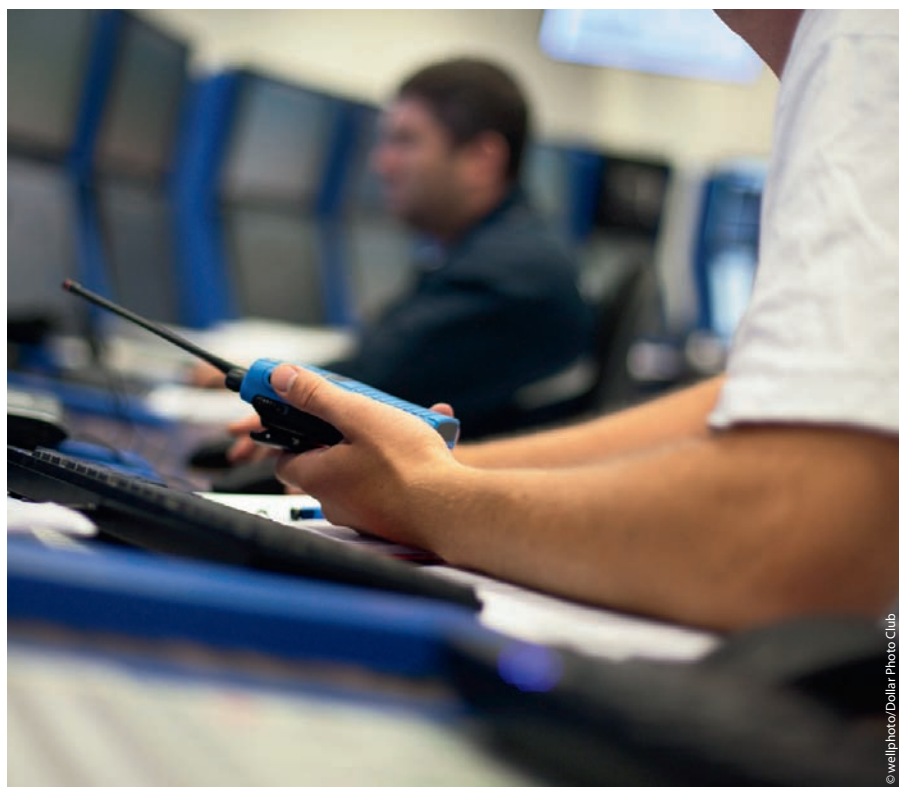
In contrast, for companies intent on building an end-to-end digital enterprise, the question of who owns cybersecurity will not be an issue. That's because IT and OT will have clearly defined roles and responsibilities, understood by both sides.

In Part 2

Bringing the IT and OT teams together and aligning their perspectives is essential in making IT/OT integration work. In Part 2 of this article we will look at modern up-to-date network infrastructures that can better support IT/OT integration.

Siemens Ltd

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Shell's mobile gas measurement system for small fields



On the coast of the Netherlands, gas reservoirs are pumped out down to the last cubic centimetre. Shell commissioned the construction of a mobile measurement station designed especially to measure this remaining amount, and now its successor has arrived.

Shell's mobile measurement station, known as *KISS*, makes it possible to approach wells and set up equipment for them flexibly, in line with the application requirements, using a portable metering skid. The station's successor — *KISS next* — has now arrived, bringing improvements and new features.

The gas is pumped up from 5000 m below the surface at the onshore deposits and then either used internally by Shell or sold to customers directly from the well. As a result, it is crucial that the gas flow is measured extremely accurately, even in the event of widely fluctuating pressures.

The quality of the untreated gas varies in its composition depending on deposits — for one thing, it is wet because it contains water and condensate. Sand and dirt are also transported to the surface, contaminating the gas. The temperatures fluctuate between -20 and +115°C — temperature drifts must therefore be compensated for.

KISS is a compact and mobile gas system for small gas fields, approximately 12 m long, 2 m wide and 2 m high. In launching *KISS* in 2004, the goal was to design an innovative type of technology for extracting natural gas in small fields — in a simple, standardised and automated manner, with reduced production, commissioning and project costs. If a well dries up, *KISS* is loaded onto a truck and transported to another well. The practical construction and installation also simplify the entire process, from planning right through to delivery. Positioned on the well, *KISS* has plug-and-play functionality, meaning it can be connected to control centres quickly and directly. The gas flow is controlled, and the pressure and temperature are monitored from there.

Optimising the gas flow measurement was crucial as the gas flow meter is one of the main components. The differential pressure measurement used previously with Venturi technology was too restrictive when it came to the flow range. As a result, different designs were required, and this often resulted in conversion work — while also having to cope with fluctuating flows. In the end, the installation conditions meant that the overall design of Venturi was too large and costly. For *KISS next* it was necessary to find a feasible solution to fit for purpose, which turned out to be the FLOWSIC600 from SICK.

"In addition to the main characteristics it offers, the measuring device needs to cover a wide range of applications and reduce the skid size significantly," explained Ying Tang, metering engineer at Shell. "We spoke to a few manufacturers so that we could gauge the application requirements for the meter performance.

"It turned out that the ultrasonic technology from SICK demonstrated clear advantages over the previous Venturi flow measurement principle."

The direct path layout of the FLOWSIC600 is more rugged in wet and dirty gas mixtures. Reflection paths, for example, quickly fail because dirt influences the reflection. What's more, the FLOWSIC600 has a much wider measuring range of 1:120, complies with the volume fraction of more than 1% (LVF >1%) for wet gas measurement and also has a longer service life.

"With the MEPAFLOW CBM software solution from SICK, we get user-friendly data access to the FLOWSIC600 with lots of diagnostic options, such as the ability to check the signal-to-noise ratio or gain parameters," said Ying Tang. "If these change, this could indicate contamination or an increase in CO₂. Any impairments which arise are displayed before they have an impact on the measurement."

In the standards and at Shell, measuring tasks with different accuracy requirements are categorised in different classes. At Shell, there are three classes: Class 1 is provided for custody transfer gas measurement involving large quantities of gas, and the uncertainty must be less than 1%. Class 2 is also for sales and taxation, but between facilities and entities with less than 2%. Class 3 is typically used for the gas production area close to the well with a maximum measurement uncertainty of 10%.

The FLOWSIC600 enabled Shell to achieve Class 2, despite the liquid content in the gas. As a result, the company can use the skids in an even more versatile manner. Local authorities can also remove one path (path 4) to achieve Class 2 requirement, as the FLOWSIC600 is certified with its four MID measuring paths.

A longer and more detailed version of this article can be read online at: <http://bit.ly/2GMJhKj>

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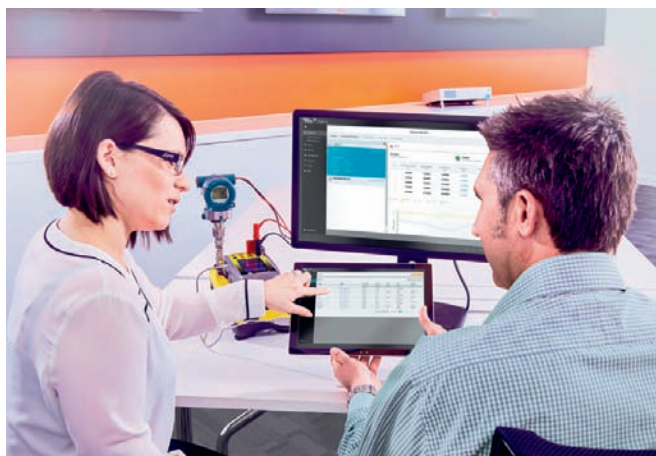
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GAS CHROMATOGRAPH OVEN WITH INTEGRATED CONTROLLER

ABB has announced the PGC5000 gas chromatograph oven with an integrated controller, the latest addition to the PGC5000 process gas chromatography product range for the chemical, petrochemical and refining industries.

Shelter space and the overall initial investment in analytical equipment can be expensive. The PGC5000 oven with an integrated controller enables the integration of a single-board computer (SBC) directly into the PGC5000B or PGC5000C gas chromatograph ovens. This not only eliminates the costs associated with one dedicated controller per oven architecture, it also reduces the overall size of the analyser shelter (up to 50%).

The oven offers user interface flexibility in three distinct options. It offers a Class 1, Division 2/Zone 2 (Division 1/Zone 1 also available) portable notebook PC with wireless or wired Ethernet connection to the ovens or a standard PC networked to the analyser LAN with wireless or wired Ethernet connection to the ovens. The third interface option is a single PGC5000A controller that can control and serve as the UI for all ovens in a single shelter. The first and second UI options allow for the use of STAR analyser maintenance system software, and for each connected oven to be controlled and displayed on the same user interface.

The product is offered with an optional secure Wi-Fi access point, with an adjustable transmission distance that limits the connection range to within the shelter. A single PGC5000A controller can connect to all PGC5000 ovens with integrated controller on the same network.

The product is available for all standard PGC5000B and PGC5000C ovens, including both the air bath and airless oven options. The option also supports the full offering of detectors: flame ionisation detector (FID); multiport and single-port thermal conductivity detector (TCD); and flame photometric detector (FPD).

ABB Australia Pty Ltd
www.abbaustralia.com.au



FINGER VALVES

Despite continuous developments in the manufacturing sector, manually operated valves still have their place in production.

SMC's VHK series of finger valves enable ease of operation and visibility.

The valve direction clearly indicates whether the valve is open or closed (shut to open is counter-clockwise) and the classification of the knob by colour helps in distinguishing between 2-port valves (grey) and 3-port valves (blue). In addition, in SMC's constant quest for energy savings, the VHK series has a sturdy construction to ensure no leaks.

The robust valves offer a poppet valve construction and can operate at a maximum pressure of 1 MPa and an operating vacuum pressure of -100 kPa. The series begins with a minimum tube diameter of 4 mm and accommodates air at temperatures of between 0 and 60°C.

In addition to the standard VHK 2-port and 3-port finger valve options, SMC also offers a flame resistant version for harsher environments.

SMC Australia | New Zealand
www.smcworld.com

ALERT OPTIMISATION

Emerson has introduced updated alert optimisation capabilities and mobile device health dashboards in the latest version of AMS Device Manager. Out-of-the-box alert filtering templates created using human-centred design principles are said to provide the potential for as much as a 60% reduction in unnecessary alerts coming from intelligent field devices. Personnel-based alert filtering and a streamlined user interface help users to quickly identify, isolate and diagnose health and calibration issues with field devices.

Engineers and technicians are frequently inundated with multiple device alerts, often stemming from a single issue within a device. AMS Device Manager resolves the problem of nuisance alerts with predefined configuration templates that filter out all alerts tangential to the core problem, leaving only meaningful, actionable notifications. In beta testing, early results show an average 58% reduction in daily alerts with out-of-the-box filtering.

Containing all relevant details, the updated alerts will help engineers create work orders and build part lists for field technicians to perform maintenance, saving valuable hours in the field.

The release also delivers the AMS Device View web interface, an intuitive browser-based display with mobile-friendly dashboards. The web interface allows users to view device health and calibration status from a wide range of devices, both on and off the plant floor. By focusing on device health rather than alerts, users can hone in on devices that need maintenance without being distracted by a long list of issues.

Emerson Automation Solutions
www.emersonprocess.com.au





THERMAL IMAGER

The MicroEpsilon TIM G7 VGA thermal imager is specifically designed for temperature monitoring in the glass industry. With VGA resolution images and faster image frequency, this thermal imager is suitable for almost any task where a high cycle speed is required.

An advanced process interface is also included in the package, which is easily integrated to existing control systems via analog, digital (USB) and Gigabit Ethernet. The G7's licence-free analysis software, TIMConnect, includes a line scan feature that provides the capability to measure the temperature profile of moving objects and identify boundaries between the heating and cooling zones of the tempered glass during the treatment process. This helps to avoid tensions and deformations in the glass surface that generally result in visual defects.

The TIM G7 has a temperature range of 200 to 1500°C, an image resolution of 640 x 480 pixels and a measurement speed of 125 Hz. The operating temperature range is 70 to 315°C (with a cooling jacket).

Bestech Australia Pty Ltd
www.bestech.com.au

CONTROLLER

PLCnext Control is Phoenix Contact's first open control platform product based on PLCnext Technology. The controller combines the robustness and security of a classic PLC with the openness and flexibility of the world of smart devices.

As an enhancement to classical IEC 61131-compliant PLC programming, PLCnext Technology makes it possible to program controllers using a high-level language, thus ensuring PLC-typical real-time performance and data consistency for high-level languages and model-based code as well. Multiple developers can work independently in different programming languages and with the development tools they prefer. The result is significantly faster application development. Open source software and apps can also be incorporated into the system in a flexible way.

The controller is said to be adaptable and open to the application of future technologies. The expanded connectivity provided by open interfaces and a direct cloud connection gives more freedom of choice, and in addition to its open design, PLCnext Control offers a high-performance CPU and large mass storage in a small housing.

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RESPONDING TO THE CHANGING MANUFACTURING LANDSCAPE

Australian manufacturers need to find alternative ways of doing business or risk being overrun by competitors with lower costs, according to Epicor.

"As the world has gotten smaller, Australian organisations face increased competition from international businesses," said Greg O'Loan, regional vice president. "For manufacturers, rising energy costs and strong

can leverage new technologies to dramatically increase efficiency, reduce costs and bring new products to market faster and more successfully.

"Businesses need to bring competitive products to market," said O'Loan. "They can then consider leveraging non-traditional ways to market to protect their existing customer base and expand into new markets. Manu-

intellectual property-based processes in Australia.

"Some companies have no choice but to stay in Australia because of the high amounts of intellectual property involved. This is often the case in high technology or unique manufacturing environments. It can also be counterproductive to offshore manufacturing of very large products because the cost of transporting them back to Australia can be high," he said.

"So it's essential for manufacturers to be smart about how they approach their business in the next few years. They must consider the various options available, including new technologies, which can help streamline their operations."

For some manufacturers, this could mean an increased focus on manufacturing execution systems (MES), which can operate as standalone software or integrated with an ERP system. MES functionality provides an overarching view of information needed to schedule and manage production in the most effective and efficient way. It includes everything from document management to reasons for waste and supports quality assurance processes. MES systems will increasingly rely on machine-to-machine information to deliver insights to help manufacturers streamline and improve operations.

"Australian manufacturers need to combine smart manufacturing, appropriate labour costing and efficiencies in the organisation to reduce costs and get control over spend," said O'Loan. "They can do this by implementing an enterprise resource planning (ERP) platform that's designed for the manufacturing industry, integrates MES functionality and is built to overcome these challenges.

"2018 will be a year of preparing for change for many businesses. This includes letting go of legacy systems that are costly to maintain and don't deliver a strong return on investment. It can be daunting for an organisation to move away from heavily customised systems but, to take advantage of innovative features and capabilities that can drive the business forward, they must modernise."

Epicor Software Aust Pty Ltd
www.epicor.com



competition from overseas companies mean Australian companies need to continue to find efficiencies throughout the business. This must happen against the backdrop of Industry 4.0, which is a new way of manufacturing that leverages automation and data exchange through the Internet of Things (IoT) and cloud technology."

Industry 4.0 is characterised by a new reliance on interoperability through IoT, information transparency through augmented and virtual reality, improved insights through analytics and business intelligence, and automation that leads to decentralised decision-making.

With traditional competitors mobilising into new areas, consolidation in the market, and external competitors entering the market, Australian manufacturers face significant challenges. Those that haven't already upgraded to a so-called 'smart factory' as part of Industry 4.0 may find themselves disadvantaged compared to competitors that

facturers that cling to traditional business models will find it hard to drive growth."

No longer reliant on distributors and retailers to sell their products, manufacturers can now go straight to market themselves by adding e-commerce functionality on their website and realising higher margins on sales.

Manufacturers' margins are under pressure because manufacturing is inherently energy-hungry. In the face of rising energy costs, these businesses need to make a choice. They can offshore their operations to a region with lower energy and labour costs. Or, they can invest in automation, such as using robots or device-to-device communication, which eliminates manual practices and reduces labour costs, relieving some of the pressure on margins.

Some manufacturers have found a third option, which is to offshore some of the more tedious and repetitive processes but retain the more complex, valuable



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FROM MASS PRODUCTION TO MASS CUSTOMISATION

The Factory of the Future is not just better than the factory of the past — it's different. Using digitalisation and connectivity, the new factory will mass-produce individualised products.

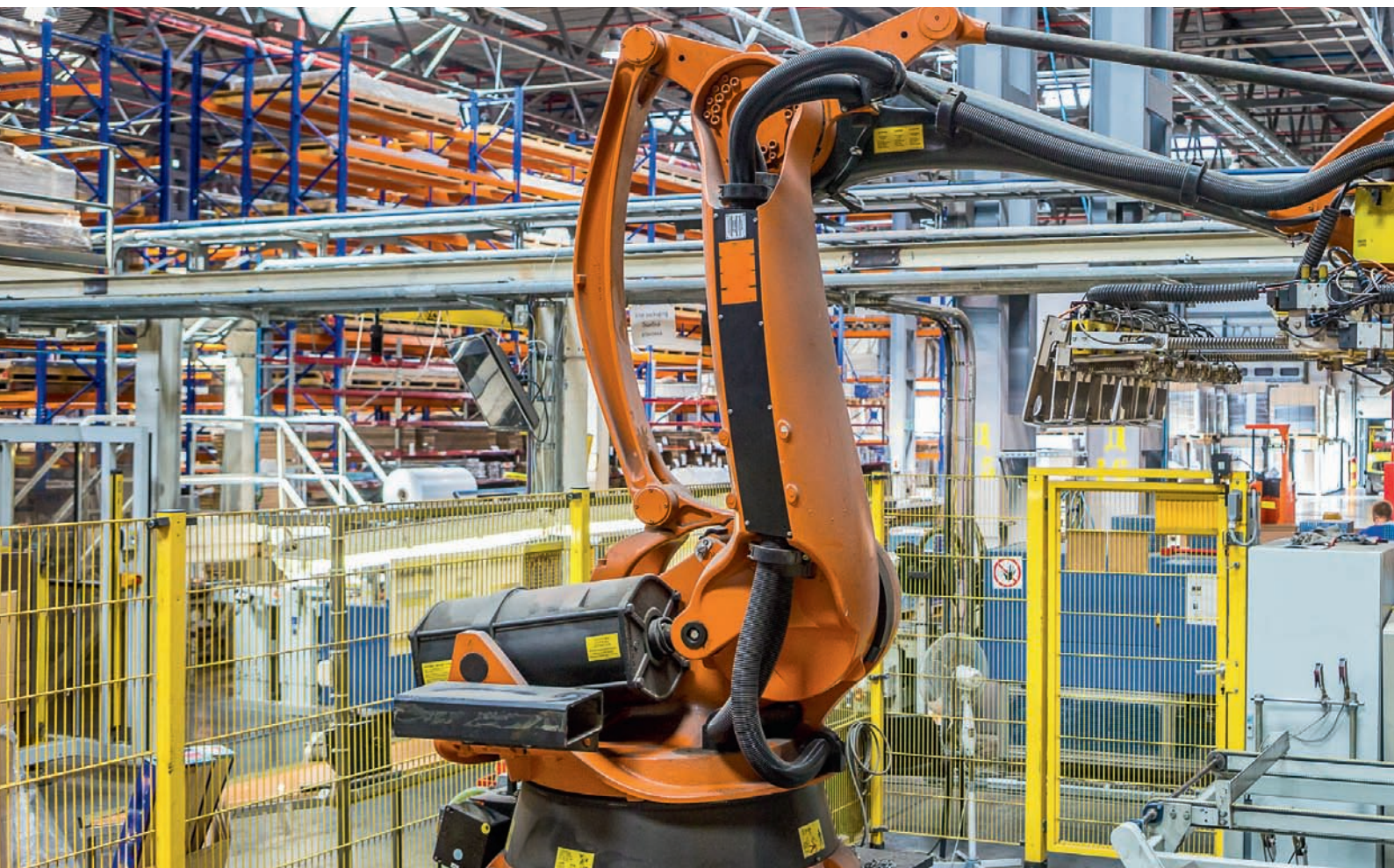
The factory of the past was founded on economies of scale. By using industrial methods to produce large quantities of the same items over a long period of time, costs should be reduced and margins improved. Ever since the start of industrialisation, the key has been these economies of scale. Capital costs were fixed and high, while variable costs were low. Now the 'new normal' in many industries is high mix and low volume instead of high volume and low mix, with much shorter production cycles.

When Richard Arkwright built his factory in England at the end of the 18th century, he used the power of water to spin cotton in a way that had never been done before. The factory eventually included several cotton mills operating 24 hours a day, employing 1000 workers on two 12-hour shifts. You can still visit Derwent Valley Mills in Derbyshire, which is now a World Heritage Site, and

you can marvel at the early days of the factory system that has been the mainstay of our industrial activities ever since: making large volumes of the same product for a long time.

Today's consumers of everything from clothing to personal electronics to foods, however, want more customised goods and 'the latest thing'. This means automation needs to be flexible to accommodate these new buying habits, with a variety of new products and packaging and much shorter product life cycles — for some goods, just a matter of months.

The fact that manufacturing has to take into account that people want to buy things that are more diverse means that the old manufacturing systems are not flexible enough to keep up. The new factory offers 'mass customisation', where every item is individualised but is produced using mass-production methods.



The challenge of customisation

The change to customised manufacturing is a big challenge. The increasing mix of products means people need to frequently work closer with robots in intermittent ways that are sporadic and less predictable — bringing them new materials, changing programs and inspecting new processes. But many industrial robots today need to remain behind cages to keep workers safe, so this means the robots often have to be shut off each time a person comes near. It simply is not productive to shut down a process every time a person comes close to a robot or other machine. Today's low-volume/high-mix production means manufacturers need both productivity and safety.

Many of the world's 1.7 million operating industrial robots are also not connected to the internet, which deprives factories of very useful intelligence that can improve performance and help human operators make better decisions. It has been estimated that only some 5% of industrial robots are connected in some way, which represents a huge potential for improvement.

Nowadays, the availability and connectivity of low-cost sensors has changed the amount of information available in digital form. The information can be used, for example, for predictive maintenance, to respond to outside influences like changing order patterns, or to avoid accidents.

Accommodating all this change brings challenges. Low-volume/high-mix means more costly engineering time and shopfloor disruptions to ramp up new production. Shorter product cycles are increasing the cost of even an hour's unplanned downtime. Get-



THE ABILITY OF COLLABORATIVE ROBOTS TO WORK SAFELY WITHOUT CAGES...MEANS THAT MANUFACTURERS ARE FREE TO FLEXIBLY DESIGN THEIR PRODUCTION FLOW TO CUSTOMERS' NEEDS, RATHER THAN BEING RESTRAINED BY FIXED BARRIERS.

ting production closer to customers may mean moving production somewhere where there's a shortage of skilled staff.

It's up to the Factory of the Future to relieve these pains, and the tools are already there — for example, virtual commissioning can allow new products to be launched faster, with testing and troubleshooting carried out before the product is installed. Cloud-based systems can bring together the operating data of all the machines of a particular type so that they can learn from one another and operators can learn from them what the warning signs for machine failure might be.

Smarter robots mean smarter production

Shopfloor disruption can be minimised by machines that learn easily, for example with 'lead-through programming' where robot actions are simply recorded by moving the arm to where it should go and saving the operation. This has been a huge simplification of a process that used to require lines of computer code written by a specialist, and it can reduce programming from many hours to minutes.

The Factory of the Future will have various kinds of robots with different levels of collaboration. In some cases these will include traditional industrial robots whose speed and position are controlled by smart software that allows people to work in close proximity without stopping production. In other cases it will mean people and robots directly sharing the same task — for example, productively assembling small electronics with many different customer options.

The ability of collaborative robots to work safely without cages also means that manufacturers are free to flexibly design their production flow to customers' needs, rather than being restrained by fixed barriers. For instance, a collaborative robot could spend its morning 'shift' gluing USB flash drives together, and then use its afternoon to place finished products into a laser engraving station.

All of these robots will be linked to central control systems for maintenance, but also to enterprise-level ordering, acquisition and dispatching systems so that a big order will automatically ensure that extra supplies are in place and that there are enough trucks scheduled to carry the product away. The system might even know that a new advertising campaign is expected to lead to higher demand next week.

Where are the workers?

Another factor influencing the factory of the future is generational changes in labour markets. All around the world it is getting more and more difficult to find people who want to do the '4D' jobs — that is, work which is dirty, dusty, dangerous or delicate. It is





even getting hard to find people to do skilled jobs in factories. An emphasis on university education instead of apprenticeships has led to a shortage of good industrial workers, even in a country like Germany, which is famed for its vocational training. But the shortage of workers is a convincing argument in favour of increased digital automation.

Today's digital generation grew up with the internet at their fingertips — they want rewarding mental challenges, not demanding physical ones. And the increasing ease of using robots means that tomorrow's manufacturing workers won't need advanced degrees. But the nature of work will certainly change — one estimate suggests that 65% of today's primary school entrants will be doing jobs that don't even exist today. The Factory of

the Future will lead to the labour of the future, and who knows what that will look like!

Robots getting smarter

The next development will be the maturing of machine learning, which is an artificial intelligence application based largely on pattern recognition. Today robots are limited to doing exactly what they are programmed to do, and they are not able to react to changes in their environment or tasks the way a person can. The ultimate goal is to have robots that are easier to use and perform better with less human intervention.

This is already evidenced by the shift from programming robots to teaching them with lead-through programming. In the future, robots will be able to learn a new task, such as picking up unfamiliar objects, from other robots. Machine learning may one day lead to self-optimising robots as well. What if all the robots that perform the same task around the world could 'huddle' at the end of their shift like people and analyse what went well and what could be improved, so they perform even better the next day?

It is difficult to imagine what Richard Arkwright would think of this Factory of the Future — mass customisation, people working side by side with robots, and even connected robots that can learn and share useful information. But what is clear is that manufacturers who invest in these solutions for flexibility, efficiency and performance today are likely to be a very big part of tomorrow.

This article is based on a piece previously published in ABB Robotics.

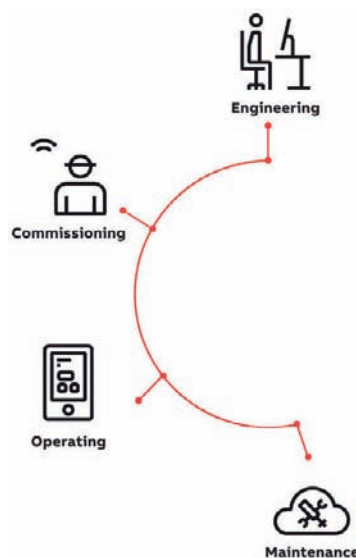
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The Factory of the Future along the whole chain

New ways of working will affect the whole chain of factory production:

- **Engineering:** Factories will be integrated from initial planning onward.
- **Commissioning:** Tools such as virtual reality make it possible to troubleshoot a new system and train staff offline before it's installed.
- **Operating:** Better decisions will come from intuitive dashboards and better information from the entire production system.
- **Maintenance:** Devices will monitor themselves in collaboration with other devices and require maintenance only when they actually need it to avoid breakdown.





COMPACT ROBOT ARM

The updated robolink solution is a complete 4- or 5-axis robot in which a control unit from Commonplace Robotics GmbH (CPR) is integrated at the base of the robot arm. The robolink is moved via four or five motor controllers. This saves space and makes the robot arm more flexible during transport or for a quick adaptation of the automation process. The modular CPR control system supplements robolink with service-friendly electronics and intuitive control software that can be used to

display and program the robot's movement sequences. For example, programs can be created using Joint, Linear, DigitalOut, Loop or If-Then-Else commands. Further components, such as image processing systems, can be integrated via plug-ins. The software is supplied on CD so that only a Windows-capable computer is required for commissioning.

Simple processes can be automated cost-effectively with the robolink modular system. These include pick-and-place applications in order picking, feeding, quality assurance, assembly tasks or image processing applications. Due to the modular system, robolink can be easily adapted to a wide variety of applications. In addition to a pre-assembled articulated arm made of joints with a wide range of gears, motors and connector modules, users can also put together individual systems. In addition, compatible grippers and lifting vacuums are available, eg, from Schunk or MM Engineering. The robolink Designer supports configuration on the internet and can also be used on a tablet, allowing, among other things, a visual simulation of movements by the rotating joints as well as a subsequent placement of order.

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Pepperl+Fuchs ecom has worked collaboratively with Samsung to develop an intrinsically safe tablet that is certified for use in Zone 1/21 and Division 1 hazardous areas. The Tab-Ex brings greater flexibility for mobile workers in the oil and gas, refining, chemicals and pharmaceuticals industries or any industry with hazardous areas.

Lightweight and compact, operating on Android 5.1.1 (optionally 4.4.4), the Tab-Ex is suitable for multiple mobile worker roles performing a range of applications, such as asset surveys, material tracking, operator rounds, inspection and maintenance. The 8" screen enables standard desktop applications to become mobile in hazardous areas, allowing workers to view and interact with SCADA/DCS systems,

enterprise systems (SAP, Maximo) and computer-aided design systems.

Built-in cameras (optional) and a range of wireless capabilities allow equipment defects to be captured as inspection and maintenance work is executed. This multitouch-enabled device is designed to make issues instantly visible to those who need to diagnose them and determine the follow-on actions.

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PNEUMATIC DEFLECTION ELBOWS

HammerTek Smart Elbow deflection elbows are used in pneumatic conveying systems to prevent elbow wear, material degradation, melting or streamers and build-up associated with material impacting the wall of conventional sweep elbows and plugged tees.

The elbow features a spherical chamber that protrudes partially beyond the desired 90° or 45° pathway, which causes a ball of material suspended in air to rotate, gently deflecting incoming material around the bend without impacting the elbow wall or generating heat.

The design prevents abrasive mining, concrete and reinforced plastic materials from wearing through the elbow wall, and friable products from degrading and generating dust, while preventing the frictional heat that causes plastic streamers and build-up of heat-sensitive materials on conventional elbow walls.

Engineered for dilute-phase and dense-phase pneumatic conveying, the elbows are offered in cast iron, carbon steel, aluminium, stainless steel and special alloys in 90° and 45° bends, with flanged and socket-weld ends in tube, schedule 10 pipe and schedule 80 pipe diameters from 32 to 457 mm.

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IIoT EDGE INTELLIGENCE SERVER

Advantech's EIS-D150 Edge Intelligence Server is pre-integrated with the WISE-PaaS/EdgeSense IoT edge intelligence and sensing integration software solution for IoT and Factory 4.0 applications. WISE-PaaS/EdgeSense incorporates sensor data aggregation, edge analytics and cloud applications for fast and easy real-time operational intelligence.

It also comes preconfigured with Azure IoT Edge and AWS Green-grass services to help customers shorten their development time based on an IoT SDK. It is powered by Intel 6th Generation Core i5 processors, with high computing capability. The EIS-D150 Edge Intelligence Server can be used as a centralised management gateway device as well as monitor the status of sensors. It can also perform as a data logic flow controller to facilitate all device interactions in a cyber-physical system such as smart grid applications.

The EIS-D150 also supports Advantech's iDoor modules and ARK-Plus modules for wired/wireless communication, such as COM, GbE, CANBus, PoE, isolated isolated digital I/O. These expansion modules help users choose the most suitable modules for their edge computing applications, providing rich data handling and networking connection capabilities, as well as peripheral support.

The EIS-D150 provides not only IoT connectivity, data manageability and analytics at the edge, but also seamless cloud integration. In factory environment management, users can utilise the EIS-D150 for environmental data processing and use the WISE-PaaS/EdgeSense with pre-integrated Node-RED for data flow logic control management. EIS-D150 can also convert environmental data and integrate with MES servers to enable data analysis, real-time reaction, and predictive maintenance for production line yield rates, and quality control.

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The APT-TH Series power transducers are used to monitor the power consumption of three-phase loads. They provide an analog signal proportional to the active power consumed by the monitored load. The three current carrying conductors pass through the three windows of the top section and the matching voltage input at the terminals.

The product is a one-piece solution for measuring power; no external current transformers are needed and installation is easy. The design ensures that the transducer is always correctly orientated.

If connected improperly by mismatching the current and voltage inputs, or placing a conductor through the sensing window back to front rather than front to back, the LED will change colour from green to amber. The LED

will also turn amber if the phase A conductor is placed through the phase B sensing window, or if power factor is lower than 0.50.

The three sensing windows are large enough for a conductor of up to 200 A and the unit is easily installed as DIN rail or panel mount.

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DRUM TIPPER FOR LOW-HEIGHT RECEIVING VESSELS

Flexicon's TIP-TITE Drum Tipper for 115 to 200 L drums features an elongated discharge cone that mates with the gasketed inlet of low-height receiving vessels, allowing dust-free transfer of free-flowing bulk solid materials.

Housed within a three-sided safety enclosure with safety interlocked doors, the drum platform is raised by a single hydraulic cylinder, creating a dust-tight seal between the rim of a drum and the underside of the discharge cone.

With a drum secured in place, a second hydraulic cylinder tips the platform-hood assembly, stopping at a dump angle of 45° with a motion-dampening feature, causing the spout of the discharge cone to mate with a gasketed receiving ring on the lid of a low-height receiving vessel. A pneumatically actuated slide gate at the spout can be opened variably for partial or total discharge at controlled rates, and then closed before returning the drum to its original position, with no dust emitted throughout the cycle.

Available in stationary and mobile configurations, the product is offered in carbon steel with durable industrial finishes, with material contact surfaces of stainless steel or in all-stainless steel finished to food, dairy, pharmaceutical or industrial standards. A diameter adapter allows for the safe and dust-tight dumping of smaller-diameter drums.

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FIBRE LASER FOR CODING ALUMINIUM CANS

Designed to meet high-speed coding demands of the beverage-canning sector, the F720i fibre laser delivers legible and durable codes on aluminium cans in challenging beverage environments with ease.

The F720i is IP65 rated, robust and compact. It is capable of maintaining continuous output in harsh and humid beverage environments reaching up to 45°C. This environmentally friendly laser provides fast return on investment due to its low maintenance, sustainable production without fluids or consumables and low energy consumption.

The F720i features 3D power concentration, a focused optical laser beam that is distributed in short intense pulses, delivering high code quality speed. The 3D power concentration produces accurate permanently readable codes, without affecting the structural integrity of the can.

Developed to maintain high levels of flexibility and coding quality at high speeds, the F720i applies standard codes at a rate of 90,000 cans/h and has the capability to deliver complex codes and promotional data of over 60 characters at a rate of 42,000 cans/h.

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7 COMMON CABLE MANAGEMENT MISTAKES

When laying cables and hoses in cable carriers and e-chains, there are a number of common mistakes that are unwittingly made that can have an adverse effect on efficiency and reliability.

To prevent unnecessary downtime, your cable management system must be correctly specified, designed and installed. Simple considerations in the beginning can prevent large problems — such as loss of continuity, insulation damage, mechanical deformation or EMI problems — later on.

Modern cable carriers can withstand longer travels, faster speeds and higher loads than ever before. Such advances in automation technology mean that certain rules of thumb, such as filling only as much as 80% of a cable carrier's cross-section, have become outdated. For this reason, below is a list of seven common cable management mistakes that you may not know you're making, as well as how to avoid them.

1. Lack of interior separation

Interior separators and shelves are crucial for keeping similar cables and hoses compartmentalised. When separation is not

used, cables can cross over one another and become tangled.

The clearance height of a compartment with several cables and hoses shouldn't amount to more than 1.5 times the diameter of the largest cable or hose. Cables with wide differences in diameter should be laid in separate compartments. Cables and hoses with incompatible jackets should also be separated (see point 6 for more on this).

The maximum cable or hose diameter corresponds to the inner height of the selected cable carrier, with additional minimum clearance. We recommend leaving a 10% clearance surrounding electrical cables, and 20% clearance surrounding hydraulic hoses. The faster and more frequently a cable carrier operates, the more important the exact positioning of the cables and hoses inside. For high-speed applications over 50 cm per second, or for high-cycle applications with over 10,000 cycles per year, cables or hoses must not be laid on top of one another without horizontal separation.



2. Uneven distribution of weight

Cables and hoses need to be laid inside a cable carrier so that they are able to move freely without exerting tensile forces along the radius. Unevenly distributed weight can result in a cable carrier that is too heavy on one side, which can disrupt movement and cause the carrier to tilt, potentially interfering with the work area.

3. Overfilled cable carrier

While it may be hard to leave seemingly available cable carrier space unfilled, overfilling a cable carrier can obstruct free movement. Cables that do not have room to move properly will interfere with the movement of the cable carrier.

Additionally, if cables become caught on one another and bind, jacket abrasion can be significantly increased. There is also a greater chance of electromagnetic interference when power

and data cables are positioned close together. As a rule, we recommend you space all power and data cables as far apart as possible in order to best prevent EMI.

4. Lack of proper strain relief

Without the proper strain relief, there is no way to control the length of the cable inside the carrier. As the cable carrier moves back and forth, the cable will pull into the carrier and bunch up, causing premature system failure. Points outside the carrier, such as connectors or end termination points, will also absorb all mechanical forces.

Typically, round electrical cables should be secured with strain relief at both ends (see Figure 1). In exceptional cases, the cables may be fixed with strain relief at the moving end only. A gap of 10–30 times the cable diameter between the end of the bend radius and the fixed point is recommended.

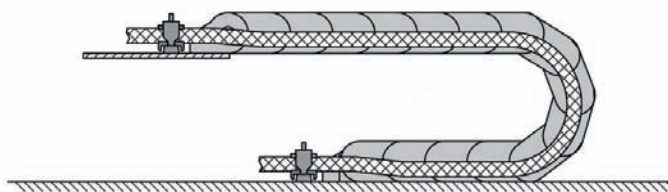


Figure 1: Strain relief on both ends of a cable carrier, resulting in the cable resting in the neutral axis.

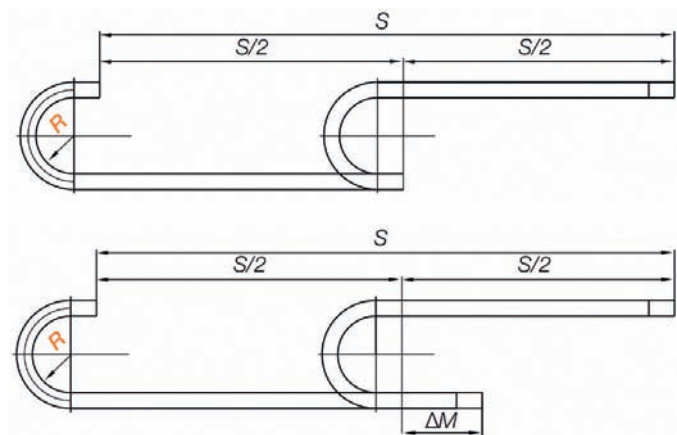


Figure 2: Calculating cable carrier length.

5. Not installing cables along the neutral axis

Correctly strain relieved cables will position in the neutral axis of a cable carrier. The cables should not be pulled tight against the inner radius or pushed against the outer radius.

Strain relief should be properly installed, then tested in both the extended and the home position.

6. Dissimilar jacket types placed next to each other

If the outer jacket of cables/hoses have different coefficients of friction and rub against one another, the harder, more resilient material will gradually wear down the softer jacket, leading to failure.

While PUR and TPE jackets have similar wear characteristics and laying these types of cables together is not a problem, mixing PVC and PUR jackets is not recommended. If jacket materials need to be mixed in the same carrier, then ensure that jacket materials are rated for cable carrier use. Rubber or thermoset jacket materials tend to have tackier surfaces and will bind inside cable carriers, and are therefore not recommended as outer jacket materials when using a cable carrier system.

7. Improper cable carrier length

If the cable carrier's length is miscalculated, then the full range of movement could be compromised. Pulled or stretched cables can result in conductor breakage.

To properly calculate the length of an energy chain cable carrier, use the following equations:

$$L_K = \frac{S}{2} + K$$

or

$$L_K = \frac{S}{2} + \Delta M + K$$

If the fixed end is located in the centre of travel, the cable carrier's length, L_K , is calculated by using half the length of travel (s) and adding the value K for the bend radius (see Figure 2). Placing the fixed end in the centre of travel is the most cost-effective solution, as it requires the shortest possible cable carrier and cable/hose lengths. When the fixed end is not located in the centre, the offset mounting value (ΔM) must be added.

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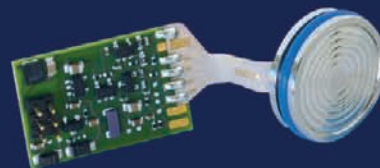
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The OPTISENS TSS 3000 is a total suspended solids sensor for wastewater applications in various industries and designed to fit into a retractable or immersion assembly. OPTISENS TSS 7000 is a total suspended solids sensor for

hygienic applications with Tri-Clamp or VARIVENT process connection, for use in applications such as in milk separation, fruit processing and other food and beverage applications. It can also be used for hygienic concentration measurement in other industries, eg, monitoring steam or cooling water circuits.

The OPTISENS TSS 3000 and 7000 are both glass-free optical sensors with multiple path lengths for various concentration ranges. They use alternating light 4-beam technology for a higher reliability of the measurement compared to classic 2-beam technologies. Two NIR LED (880 nm) light sources and two detectors compensate for most errors caused by dirt, ageing or light source variations. By measuring directly through a PP layer, measurement errors and sealing problems typically caused by glass windows cannot occur. Both can be operated with the MAC 300 analytical transmitter.

MAC 300 is a menu-driven analytical transmitter for OPTISENS TSS, pH/ORP and COND sensors. It can be operated with up to three different analytical sensors, processing their signals to the control system via up to six analog 0/4–20 mA outputs, relay outputs or optional Modbus. It features a backlit LCD display, robust housing (IP66/67, NEMA 4/4X) for wall-mount or panel-mount installation, optional live trending and data logging, and an SD card slot to save parameter sets or upload new firmware.

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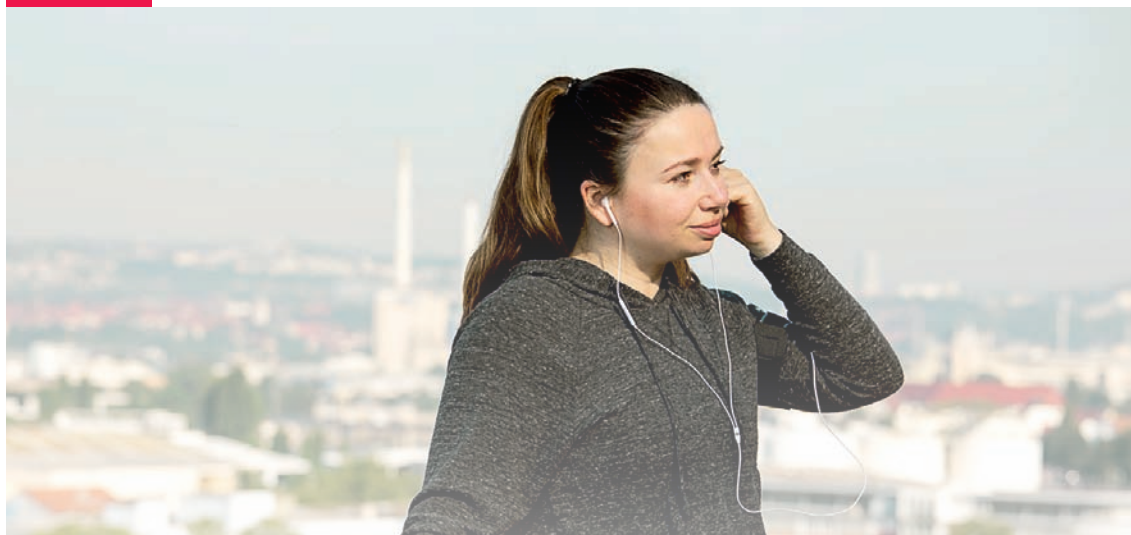
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HANDHELD pH METERS

Mettler Toledo Process Analytics Pro2Go handheld pH meters are a suitable alternative to making lab measurements and for when an inline sensor is not required.



The pH meter combines ergonomic design with measurement features in a low-weight instrument. The rugged, water-resistant meter is compatible with both analog and the company's digital Intelligent Sensor Management (ISM) pH/redox probes. ISM's features include plug-and-measure operation for error-free set-up and predictive diagnostics that indicate when the attached sensor will need to be calibrated, maintained or replaced.

Compatibility with ISM and analog sensors means the same pH/redox probes used for inline measurement can also be used with the pH meter.

The meter has a storage capacity of 2000 measurements, a user and sample ID feature and data transfer to PCs via a USB interface, allowing secure data management.

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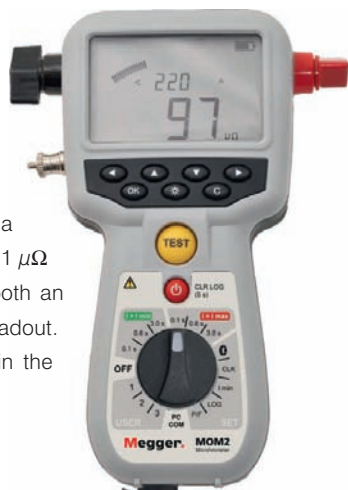
MICRO-OHMMETER

The Megger MOM2 micro-ohmmeter measures resistance with a resolution as low as 1 $\mu\Omega$. The product weighs 1 kg and is designed to run all day without needing a recharge. It is available to rent from TechRentals.

The MOM2 uses the DualGround method, meaning that the test object will be grounded on both sides throughout the test, without affecting the results. This provides a safe, fast and easy workflow and shifts focus to the test rather than the equipment.

The product stores 190 test values, with easy transfer to PC via Bluetooth. It has an auto range of 1 $\mu\Omega$ to 1000 m Ω . The display offers both an analog arc and a dual digital readout. Kelvin probes are also included in the rent for a 4-wire Kelvin test.

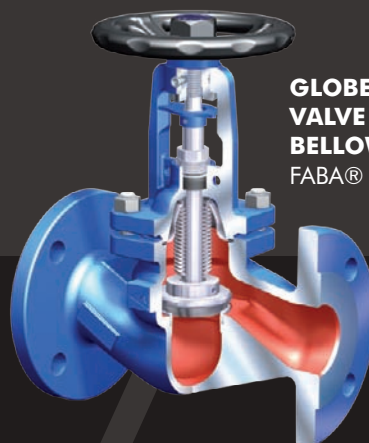
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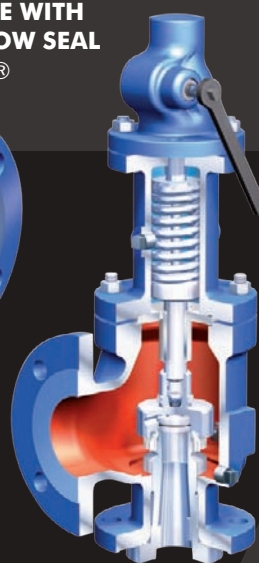
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OUTDOOR EQUIPMENT SHELTER

Intertec has developed an unusual outdoor equipment shelter. Its outdoor PERI SHELTER for protecting field-based instrumentation and automation makes all the system components that are required for normal operation accessible via the exterior of the building. This 'inside out' design approach can reduce shelter sizes and simplify construction and installation, according to the company.

The product eliminates the need to make plant buildings blast-proof and fire-resistant because personnel might be inside. It also offers major reductions in size by eliminating desks, control panels, door opening spaces, aisles/walkways/escape routes etc, and simplifies internal atmospheric control requirements.

Panel-mounting enclosures on the exterior provide access to electrical connection and I/O termination points and cooling systems. A touch-screen HMI panel that sits on an external wall allows operators on the ground to monitor the PLC or make adjustments to control programs locally via an inspection door.

The shelters also feature a novel fault tolerant cooling system that is suitable for hot locations, based on a combination of passive and active cooling. Passive cooling operates independently of an electrical power supply, ensuring that the shelters remain cool even during a power outage. An additional powered water cooler improves the efficiency of the cooling system. A third air cooler provides an independent backup.

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Ralston Instruments developed a way to standardize pressure calibration using templates that are consistent across your company

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BIMETAL TEMPERATURE SWITCH

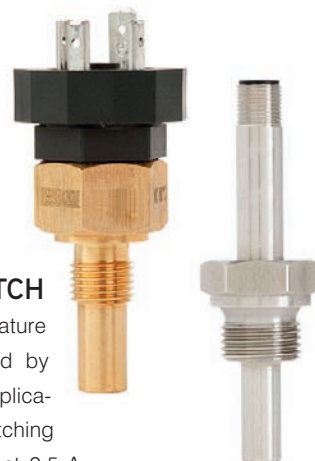
The TFS135 bimetal temperature switch has been designed by WIKA for a wide range of applications and is suitable for switching voltages of up to 250 VAC at 2.5 A.

The TFS135 conforms to the EU low-voltage directive. It has been designed for switching temperatures of +50 to +130°C, selectable in stages of 5 K and set permanently on delivery. With a vibration resistance of up to 10g, the TFS135 is designed to operate reliably even under harsh conditions. Electrical plug connections make it easier to commission.

The switch is primarily used for the protection of plants and end devices against overheating. The bimetal disc of the TFS135 detects the temperature and triggers the switch contact (normally closed) on reaching the nominal value. After cooling to the reset temperature, the circuit is closed once more and the monitored item is placed back into normal operation.

WIKI Australia

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ENCODERS

The AFS60 Inox, AFM60 Inox and DFS60 Inox are high-resolution encoders from SICK, suitable for a range of applications.

The AFS60 absolute singleturn encoder and the AFM60 absolute multiturn encoder offer a high resolution of 18 bits (AFS60 Inox) or 30 bits (AFM60 Inox) and a large selection of programmable parameters. Due to their high resolution, high IP enclosure rating and stainless steel housing they can be used in applications with harsh ambient conditions and strict requirements regarding resistance to aggressive media such as cleaning agents or salt.

The encoders are equipped with the SSI interface; the AFM60 Inox is also available with combined SSI plus incremental and SSI plus sin/cos interfaces. Both encoders can be programmed via the PGT-08-S PC-based programming device or the PGT-10-Pro handheld programming device.

The DFS60 Inox is a high-resolution incremental encoder with a diameter of 60 mm in stainless steel design. It offers a large range of mechanical and electrical interfaces and can also be programmed by the user. The rugged mechanical design, the wide temperature range as well as the IP67 enclosure rating make the DFS60 Inox suitable for applications in harsh ambient conditions. The range of options for programming the electrical parameters includes the output signal level, the number of pulses per revolution or the zero pulse width.

These encoders are suitable for use in the food and beverage industry, packaging machines, medical technology and outdoor applications in port and offshore plants.

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HIGH-CURRENT FEED-THROUGH TERMINAL BLOCKS

Phoenix Contact is extending its range of powerful high-current feed-through terminal blocks with the UW95 screw connection panel feed-through terminal blocks, suitable for large conductor cross sections from 25 to 95 mm².

With the single-position, alignable terminal blocks, users can transmit currents of up to 232 A and voltages of up to 1000 V (600 V UL) safely. The panel feed-through terminal block can be mounted in corresponding housing sections without tools and is suitable for panel thicknesses of



1 to 5 mm. Versions with a horizontal or vertical conductor exit are available for different applications. Special moulded versions create a good housing seal, even with low-viscosity moulding compounds.

Phoenix Contact Pty Ltd
www.phoenixcontact.com.au

HYBRID SAFETY I/O MODULE

Turck has announced the addition of the CIP hybrid safety I/O module to its range of fieldbus technology products.

The hybrid safety concept from Turck combines both safety I/O and general-purpose I/O in a single, rugged, on-machine, remote I/O device. The CIP Safety (TBIP) module expands the existing hybrid safety range, which already includes an option for PROFI-safe over Profinet.

Both IP67 hybrid modules can be adapted to the actual signal requirements of an installation through the use of configurable I/O points and by leveraging the flexibility of IO-Link. On the safety side, the hybrid modules offer two safety inputs for connecting safety sensors, such as light curtains or emergency stop buttons. Two additional safety channels can be used as either inputs or outputs. The general-purpose (non-safety-related) side includes four configurable discrete I/Os capable of switching up to 2 A when used as outputs. Two IO-Link master ports are also available, which offer an additional 32 points of configurable discrete I/O when used with Turck IO-Link hubs.

These devices can be used as remote safety I/O, or even operated as a standalone safety controller for local safe I/O, which allows the implementation of safety functions without the need for a safety PLC while still providing safety diagnostics and general-purpose I/O data to a higher level non-safety PLC.

The IP65/IP67/IP69K degrees of protection allow use in demanding environments. Decentralised plants and modular machine concepts can be implemented without the need for additional control cabinets.

Turck Australia Pty Ltd
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FLOWMETERS WITH PROFINET

The Krohne MFC 400 signal converter is now available with a Profinet I/O option, so now all OPTIMASS x400 coriolis mass flowmeters (compact and field versions) can be equipped with Industrial Ethernet communication, complementing the existing HART 7, FOUNDATION Fieldbus, Profibus PA and DP as well as Modbus options.

With Profinet I/O, all measuring, process and diagnostic information from the meters is available in real time via a single communication channel, allowing for convenient integration of new meters: the MFC 400 supports network functions such as auto-negotiation, auto crossover, auto polarity and network diagnostics, and is automatically added to

the communication path topology when connected to the network. It also supports Media Redundancy Protocol: in the event of a line or device failure, the MFC 400 instantly switches to an alternative communication path when installed in supporting topologies. A web server is not required: standard functions such as zero flow calibration or counter reset can be performed directly.

One or two M12 (D coded) connectors allow installation in all topologies with data transfer speeds of up to 100 Mbps. An additional external switch is not required as the MFC 400 features an integrated managed Ethernet switch, providing additional functionality including diagnostics. Conforming to the NAMUR standard NE 107 for status and error handling, the MFC 400 provides extensive self-checking of internal circuits and information regarding the health of the measuring sensor as well as information about current process conditions, such as indication of two-phase flows, density or temperature.

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QUALITY MONITORING IN MILK PROCESSING

PART 2

In Part 1 the necessary steps in the quality monitoring of whole milk production were introduced and the issues around milk delivery, storage and minimisation of product loss discussed. In this article, the issues of food safety and shelf life maximisation through heat treatment are described.



The main components of milk are water (85–88%), fat, proteins, lactose (milk sugar) and minerals (salts). There are also trace amounts of other substances such as pigments, enzymes, vitamins, phospholipids (substances with fatlike properties) and gases. The relative amount of these constituents is variable, due to the natural origin of the raw product and its dependence on natural biological variation between animals, and both seasonal and locational (regional and farm-specific) variation. The process of milk standardisation is intended to produce whole milk for retail sale that has a standardised minimum fat content, while also producing the cream (fat) by-product that can be used for secondary products such as butter, cream, yoghurt and cheese.

The composition of milk in Australia is regulated by the Food Standards Code (Standard 2.5.1), published by Food Standards Australia and New Zealand. According to FSANZ¹:

The standard for packaged cows' milk for retail sale requires that it contain at least 3.2% fat and 3.0% protein. Skim milk must contain a maximum of 0.15% of fat and a minimum of 3.0% protein.

The Code allows milk processors to adjust the components of milk, such as lactose, protein, fat or vitamins and minerals by adding or removing those components to produce a standardised product.

Typically raw cows' milk delivered from the farm contains approximately 4% fat. The standardisation process therefore involves producing 'full cream' milk and skim milk that meet the requirements of the standard, the remaining cream/fat being available for the manufacturing of other products.

Milk standardisation

The general process of standardisation involves separating the raw milk into skim milk and cream using a centrifugal separator. Typical (rounded) figures for fat content (see Figure 1) may be that the skim milk from the separator has a fat content of 0.05%, and the cream has a fat content of 40%. Some of the cream is then remixed with the skim milk to produce full cream milk standardised to the required level of fat (in the figure 3% and in Australia at least 3.2%).

Standardisation measurements

For precision in the process it is not only necessary to measure the fat content during the re-mixing process, but also to measure other variable parameters such as fluctuations in the fat content of the incoming milk, fluctuations in throughput and fluctuations in preheating temperature. As most of the variables are interdependent, variations in any one stage of the process can result in deviations in all stages.

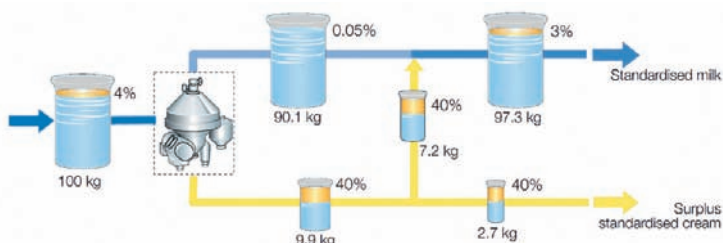


Figure 1: A generalised representation of the milk standardisation process.²

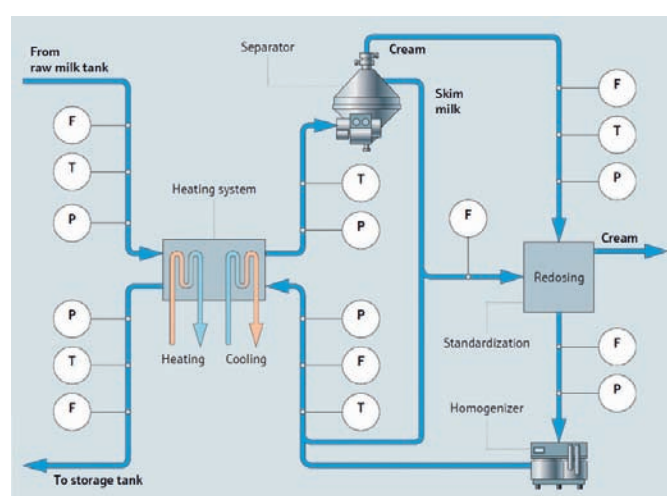


Figure 2: The milk standardisation process.

The raw whole milk is heated to 55–65°C in the pasteuriser/heat exchanger before being passed to the separator. Reliable performance of the separator also depends on the pressure in the skim milk outlet being kept constant — this pressure must be maintained regardless of downstream variations in flow or pressure, so it is necessary to monitor the outlet pressure to control a constant pressure valve.

Online density measurement is commonly used for the control of the milk standardisation, at the re-mixing stage. The densities of skim milk and milk fat are known, although temperature-dependent (see Table 1). The density change on the mixture addition of skim milk and cream is used to monitor and control the fat content of the standardised milk.

Product	Composition		Density (g/cm ³)			
	Fat (%)	SNF (%)	4.4°C	10°C	20°C	38.9°C
Skim milk	0.02	8.9	1.036	1.035	1.033	1.026
	0.02	10.15	1.041	1.040	1.038	1.031
Whole milk	4.0	8.95	1.035	1.033	1.030	1.023
	3.6	8.6	1.033	1.032	1.029	1.022
	12.25	7.75	1.027	1.025	1.020	1.010
	11.3	8.9	1.031	1.030	1.024	1.014
Cream	20.0	7.2	1.021	1.018	1.012	1.000
	36.6	5.55	1.008	1.005	0.994	0.978

Table 1: Density of various dairy products as a function of fat and solids-not-fat (SNF) content.³



Figure 3: Hygienic electromagnetic flow meters offer advantageous features for milk processing.

Instruments for monitoring flow and density

Measuring milk flow and density can be accomplished by any number of technologies, but can be combined accurately in a single instrument by utilising a Coriolis meter. These types of meter are ideal for virtually all fluids, measuring several process parameters — including both mass flow and density directly in the pipeline. Coriolis meters designed for the dairy industry can also measure temperature and viscosity, and be configured to viscosity, °Brix, and % Milkfat.

Additionally, electromagnetic flow meters are ideal for batching, and for the receiving and feed lines of product or CIP flows. They can also handle pulsating flow and can be used for empty pipe detection. Those with integrated conductivity measurement allow for continuous monitoring of phase changes and product identification.

Instruments for monitoring pressure

Pressure conditions in the feed line and the outlet of a separator require reliable pressure monitoring. Pressure instruments that offer a flush stainless steel or ceramic diaphragm, and a wide variety of hygienic process connections, provide the highest flexibility to retrofit into existing applications. Not only should they provide reliable and accurate pressure measurement, but they should be condensation tight and easy to clean.

Heat treatment

Raw milk can contain a range of pathogenic microorganisms, the most resistant to treatment of which is the tubercle bacillus (tuberculosis). Fortunately they can all be killed by heating the milk to a minimum of 63°C for 10 minutes, and general practice is to maintain the temperature for 30 minutes.

In addition to pathogenic microorganisms, milk also contains other substances and microorganisms that can spoil the taste and shorten the shelf life of the milk. A secondary purpose of heat treatment is to destroy as many of these as possible, which requires more intense heat treatment than is needed to kill the pathogens. This secondary purpose for heat treatment has become more important in recent decades, as dairies have become fewer in number and larger, and are located at greater distances from both the farms and the consumers — a significant factor in the Australian dairy industry. Despite chilling milk throughout transport and storage, the time delay in processing and consuming allows more time for these bacteria to multiply — chilling milk to 4°C slows the process but doesn't stop it completely, and once the temperature rises above 4°C, the number of bacteria multiply rapidly (see Figure 4).

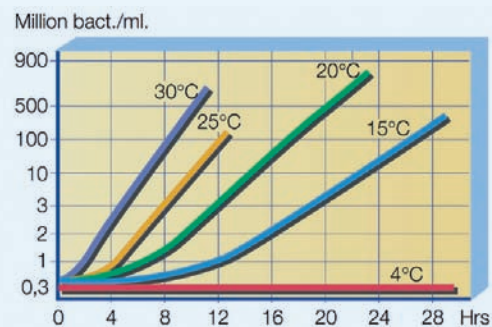


Figure 4: Influence of temperature of bacterial development in raw milk.⁴

Because heat treatment has potential detrimental effects on the milk product, such as changes to flavour and appearance, or can impair secondary processing such as cheese making, the management and control of heat treatment processes is a critical factor in maintaining product quality as well as safety.

Pasteurisation

The minimum temperature and time mentioned above are used in a process known as LTLT (low temperature, long time) pasteurisation. Modern dairies in contrast use a process called HTST (high temperature, short time) in which the milk is heated to 72–75°C for a shorter time of 15–20 seconds. It is easier to maintain the higher temperature for this shorter time in a holding tube than it is to maintain a lower temperature for longer. After pasteurisation, the milk must be cooled to 4°C for packaging and transport.

The most energy-efficient way to achieve the various stages of heating and cooling is to use a multiple stage heat exchanger in which the hot pasteurised and raw cold milk are used as part of the heat transfer process. By this method, the hot pasteurised milk is cooled in the heat exchanger by transferring some of its heat to not only a cooling fluid such as cold water, but also to the cold raw milk in an adjacent section of the exchanger. In this way, less steam heating is required to bring the raw milk up to the required temperature. Regenerative heat exchange in this way can recycle as much as 95% of the heat from the pasteurised milk.

The risk with regenerative heat exchange is that any leak that may occur internally in the heat exchanger could lead to raw milk contaminating the pasteurised milk. To mitigate this risk, the flow of hot milk entering the heat exchanger for cooling must be pumped through the heat exchanger at a higher positive pressure than that for the raw milk by using a booster pump.

Thermisation

In some cases it is not possible to pasteurise and process all the milk immediately after reception, and the storage of raw milk for days or even hours, despite chilling, can result in degradation of the milk before it is even processed.

Thermisation is a process carried out by many dairies to temporarily inhibit bacterial growth. It involves preheating the milk to a temperature just below the pasteurisation temperature for about 15 seconds.

To prevent bacteria from multiplying after thermisation, the milk must be rapidly chilled to 4°C or below and it must not be mixed with untreated milk. This process should be applied only in exceptional cases — ideally pasteurisation of the incoming milk should be completed within 24 hours of receiving.

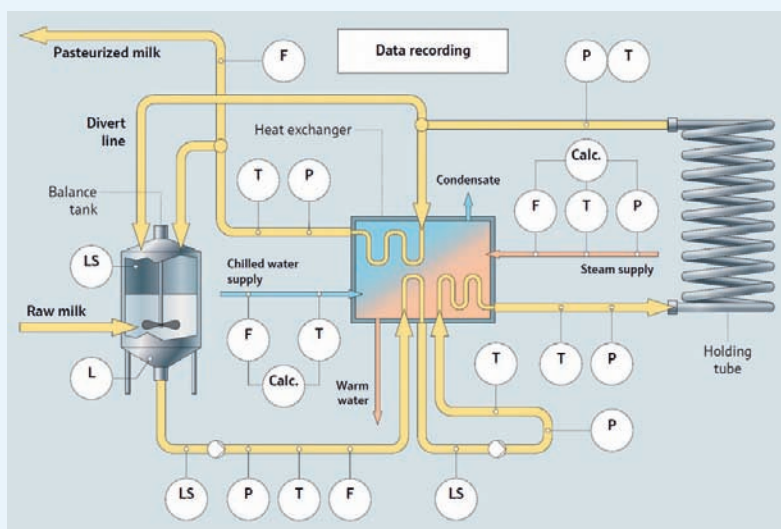


Figure 5: The milk heat treatment/pasteurisation process.

Temperature measurement

As the most critical process in relation to food safety, the milk heat treatment process must be accurately and continuously monitored and recorded, with correct temperature being the most primary consideration. Accurate and fast-responding temperature instruments are required at a number of points in the process:

- Raw milk stored in the balancing tank and flowing into the heat exchanger, as well as the pasteurised milk after cooling must be monitored to be sure it remains at 4°C.
- The milk leaving the heat exchanger and entering the holding tube as well as the milk leaving the holding tube must be monitored to ensure the pasteurisation temperature is achieved and compared to ensure that the temperature is maintained for the required holding period. This data must be continually logged for food safety audit purposes. If the temperature is not maintained for the required time, then the milk must be diverted back to the balancing tank to avoid compromising food safety. Fast temperature response is essential.
- The heat exchange process also requires the right flow of water for cooling and steam for heating to maintain the correct temperature flows, so temperature instruments are also required to monitor and control the temperature of these fluids.

If a thermisation process is being used for stored raw milk, then fast-responding temperature instruments will also be required to monitor the heating and cooling process, as well as the storage temperature.

Instruments for monitoring temperature

Due to the rapid heating and cooling used in milk processing, temperature sensing in milk heat treatment must be fast and accurate. It is essential that temperature instruments that are used have the fastest possible response. Today, temperature instruments are available that have a t_{90} response time of under 1.5 seconds. It is also important that they have a high vibration resistance (better than 60g) for plant safety.

To minimise calibration time (and maximise plant uptime) newly designed temperature sensors provide for two-piece construction, whereby, the first piece (thermowell) is permanently welded into the process and the second piece (temperature measuring element) is inserted into the thermowell by means of a simple bayonet connection.

Pressure measurements

The next most important parameter to measure is pressure. As stated above, when using regenerative heat exchange, the differential pressure between the raw milk and pasteurised milk sides of the

heat exchanger must be measured and maintained to ensure there is a higher pressure on the pasteurised milk side.

Under normal continuous process conditions, the pressure would normally be constant and within a certain range. Abnormal variations in the pressure and flow rate anywhere in the process may be an indication of a leak or potential failure in the heat exchanger or elsewhere. The same applies for heating and cooling fluid lines, where a leak could result in these fluids also contaminating the milk.

Instruments for monitoring pressure

Monitoring pasteurised milk pressure will require a high level of hygienic safety, and so an appropriate instrument designed to be food safe with a ceramic or stainless steel sensor membrane and tolerant of CIP wash-down chemicals is required (Figure 6).

Level measurement in the balance tank is also important to monitor, and is typically performed using hydrostatic pressure measurement, in the same way as for the raw milk receiving tanks.

Flow measurements

As a continuous process, empty lines could create problems for the heat exchanger, whether it be the raw and pasteurised milk product, the heating steam or the cooling fluid. It is therefore necessary to make sure that the flow rate through the heat exchanger is constant and balanced, and also to monitor the flow and consumption of steam.

Instruments for monitoring flow

The requirements of flow measurement in dairy heat treatment (sanitary, accurate and robust) can all be fulfilled with the use of a magnetic flow meter.

The accuracy of a typical magnetic flow instrument used for heat treatment flows is unaffected by large flow variations. Since the magnetic measurement principle is virtually independent of pressure, density, viscosity and temperature, it is ideal for monitoring flow monitoring in the heat treatment process and can provide empty pipe detection.

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2. Tetra Pak Processing Systems AB, *Dairy Processing Handbook*.
3. Goff H D, Hill A R 1993, *Dairy Chemistry and Physics, Dairy Science and Technology Handbook*, VCH Publishers, vol.1.
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Figure 6: A hydrostatic pressure instrument.

COMPRESSORS

The latest generation of ESD series rotary screw compressors from Kaeser are said to consume up to 8% less energy than previous models, yet deliver 6.5% higher flow rates. Numerous optimisation measures, such as improved Sigma Profile screw compressor blocks and the use of IE4 motors, have further improved the overall energy profile.

The high performance of compressors is due to a flow-optimised rotary screw compressor block with energy-saving Sigma Profile rotors, while the use of IE4 Super Premium Efficiency motors exceeds current requirements for the use of IE3 class motors. The Electronic Thermal Management system delivers additional energy advantages, as do the environmentally friendly fluid filter and integrated Sigma Control 2 controller.

Electronic Thermal Management consistently controls the oil temperature within a constant, safe differential relative to the dewpoint, which also helps avoid unnecessarily high screw compressor block discharge temperatures, thereby contributing to higher overall energy savings and extended service life. With optional heat recovery equipment, a second Electronic Thermal Management system ensures optimum use of the heat energy that arises from the compression process.

The fluid filter elements simply sit in an aluminium housing, with no need for a sheet metal enclosure. The filter elements themselves are completely free of metal, making disposal straightforward: at the end of their service life, they can be thermally disposed of without additional pretreatment.

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The Puls PIRD20.241 is a diode redundancy module. Part of the PIANO range, it enables users to build a 1+1 or N+1 redundancy system to ensure operational reliability.

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ROTARY JET HEADS

Alfa Laval has added three rotary jet heads to its range: GJ A2, GJ A6 and GJ PF FT.

This provides easy installation of rotary jet head technology in small size tank openings like 3" or 4", where static spray ball and rotary spray heads are normally mounted today. By retrofitting with one of the three small jet heads, the user avoids reworking the tank to accommodate upgrading tank cleaning equipment, meaning low installation cost.

When higher cleaning efficiency is required, it is easy to upgrade static spray balls to the GJ Rotary Jet Head

technology. Simply unclip the static spray ball and replace it with a new clip-on rotary jet head that uses a cleaning pattern ensuring dynamic and effective distribution of water to the inner tank surfaces. The high mechanical force generated by the strong jet impingement efficiently removes remaining products and residues to provide the best conditions required for hygienic production.

Rotary jet heads are said to clean tanks 70% faster than the static spray ball technology. Because of faster cleaning, less water and chemicals are used, thereby reducing operating costs by up to 80%, according to the company. They provide easy cleanability, a safer end product and greater overall output for all hygienic applications.

Alfa Laval Pty Ltd
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MANAGEMENT SOFTWARE

The latest version of Hirschmann's network management software, Industrial HiVision 7.1, improves functionality with the addition of features for PoE detection and management, as well as added support for configuring emerging technologies such as TSN.

In many industrial facilities, Ethernet networks are growing and changing quickly, and it is increasingly difficult to manage and secure them while fault-finding efficiently with precision.

The latest version makes it easier to control and act on factors that impact the network as a whole. These include a graphical history display, which provides comprehensive graphical indicators of fault events, as well as easy configuration of time-sensitive networking (TSN) systems with MultiConfig.

The enhanced capabilities of Industrial HiVision 7.1 allow industrial manufacturers to optimise the use of available power with the Power over Ethernet (PoE) Wizard. The IIoT is driving smaller and smaller devices typically powered by PoE. As a result, fewer switches are required to meet needs and less energy is wasted, leading to a lower total cost of ownership. Hundreds of SNMP-enabled industrial devices can be configured simultaneously, from any manufacturer, both during commissioning and live operation.

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Automating yoghurt production in Chobani's new plant

Chobani is a fast-growing, dynamic yoghurt company that was founded in the United States, with the belief that people have great taste but need great options. With a mission to make high-quality, great-tasting yoghurt available to more people, Chobani decided to spread its wings to Australia.

Since purchasing a local Victorian dairy company in 2011, Chobani has also invested in a new greenfield facility to manufacture its yoghurt locally alongside the existing manufacturing plant.

With a strong focus on automation, Chobani called on Metromotion Controls, a systems integrator specialising in control and automation systems, to facilitate the design, management and implementation of the new \$30 million facility.

In addition to the new manufacturing plant, Metromotion was also commissioned to implement Chobani standards to automate the existing site. The task at hand was to use the latest technologies from Rockwell Automation to automate both new and existing processes at the plants.

With increasing demand for Chobani yoghurt around the world, meeting global supply agreements was a key priority for the company, as failure to do so would result in significant penalties being enforced. As such, Metromotion Controls was required to meet strict project timelines so the plant could be up and running quickly and effectively.

Chobani has a strong focus on automation and at the time of building the factory required 'on the ground' automation and electrical resources from Metromotion Controls. This work involved facilitating the site power upgrade; building services and process power distribution; factory-wide automation integration, including process, packaging and site services; and commissioning and ongoing support both on-site and remotely.

Metromotion Controls has enjoyed a longstanding relationship with Rockwell Automation and NHP Electrical Engineering Products (NHP) and had no hesitation in calling on them to provide the control and automation technologies required at the plant.

According to Andrew Sprigg, control systems engineer at Metromotion Controls, "Rockwell Automation is the automation vendor of choice for Chobani, so by having one brand for standardisation, maintenance, service and support is streamlined for the plant.



Yoghurt production is fully automated using the latest control and automation technologies from Rockwell Automation.

"The cooperation between Rockwell Automation, NHP, Metromotion and Chobani has worked really well and this good working relationship has helped everything to flow smoothly," he said.

The yoghurt production process is fully automated using the latest control and automation technologies from Rockwell Automation. EtherNet/IP is used as the communications protocol, with all devices connected via the one network.

The architecture at the plant has been designed so that five independent ControlLogix controllers are used for a specific process role such as raw milk processing, pasteurising, clean-in-place (CIP), fermentation and filling. Each part of the process is further broken down into modular skids. A control panel with FLEX I/O communicates the process information back to the ControlLogix controller over Ethernet. This provides the capability for remote access diagnostics of equipment easily over the Ethernet network. The motor control meanwhile utilises PowerFlex drives from Rockwell Automation that are located in a centralised motor control centre and communicate over the Ethernet network.

"These control and automation technologies provide access to remote diagnostics and simplified programming. Another feature of the Rockwell Automation solution is that it is very easy to upgrade the existing system using the same architecture and stock that is readily available in Australia," explained Sprigg.

The new manufacturing plant meets all of Chobani's manufacturing requirements and is achieving operational efficiencies. As the company's product range grows, Metromotion Controls has been instrumental in providing automation and process control solutions to meet these changing requirements.

"Chobani is undergoing new product development work which needs new controls and new processes, which has been a key focus for us as well as maintaining the plant," said Sprigg.

Minimising downtime is also of critical importance to Chobani, as yoghurt manufacturing is a continuous process. If that process was to be affected by unplanned downtime, the whole production process would halt and the plant would need to be cleaned and then restarted.

The Rockwell Automation solution provides a web interface with diagnostics, which allows operators remote access to the system. This makes it easy to find diagnostic information and identify things that may need attention.

"The biggest help to Chobani to reduce downtime during the infancy of the plant was the ability for us to quickly gain remote access to any device and find detailed information fast, which in turn allowed us to reduce downtime," said Sprigg.

To help keep yoghurt production flowing, Chobani has a comprehensive services agreement in place with Rockwell Automation and NHP that is designed to minimise downtime and maximise reliability through effective asset management.

In addition to this assurance agreement, Chobani also has a parts management agreement which provides spare parts on-site so that the plant can be up and running again in the event of unscheduled downtime.

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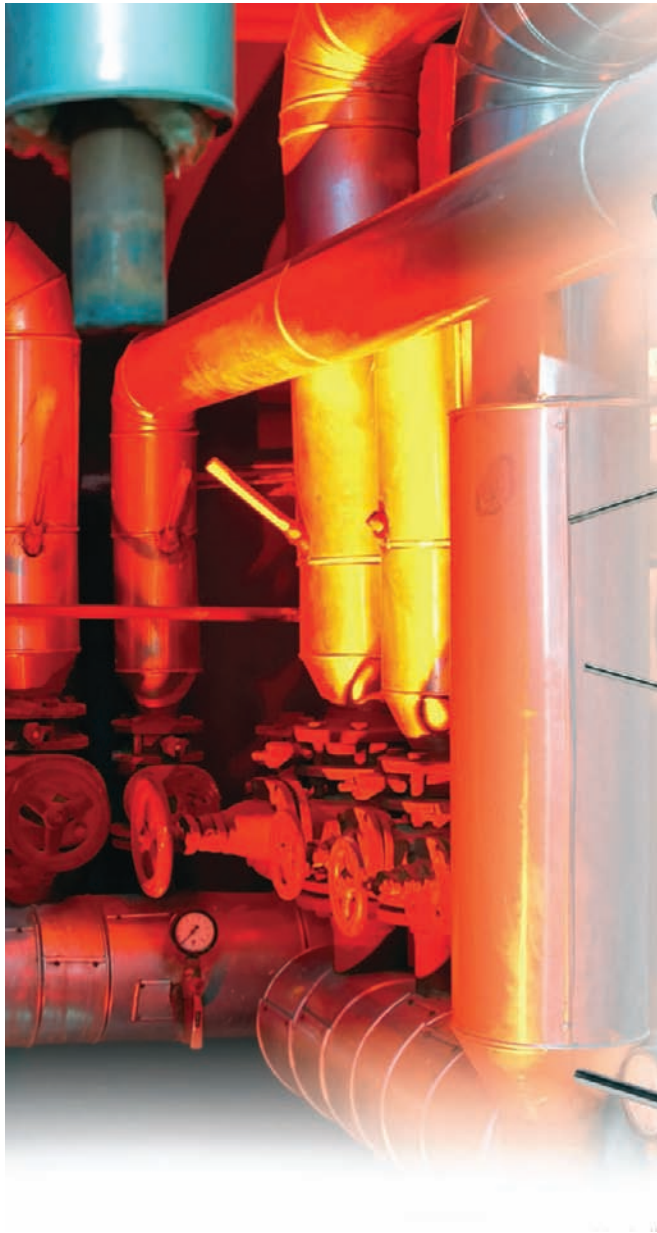
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The Hioki PW3198 is a power quality analyser that detects power supply problems. Suitable for demanding applications, this instrument enables operators to perform on-site troubleshooting, conduct preventive maintenance, and avoid accidents by effectively managing power quality. It is available to rent from TechRentals.

The product has an easy set-up function with presets and records voltage, current, pf, f (Hz), kVA, kVAR, kW, harmonics (THD and individual to 50th order), flicker (IEC6100-4-15) and inrush current. Transient overvoltage can also be measured up to 6 kV peak at 2 megasamples per second.

The unit meets the CAT IV safety standard and international standard IEC 61000-4-30 Edition 2 Class A. It includes three fixed 1000 A CTs, four flexible 500/5000 A CTs and one 200 A AC/DC CT. It is also supplied with analysis software (Hioki 9624 PQA-HIVIEW) for reporting, compliance and record management.

TechRentals

www.techrentals.com.au

ETHERNET SWITCHES

Lapp Group has released a line of four switches for industrial Ethernet networks under the name ETHERLINE ACCESS. The switches feature a redundant power supply and robust metal housing for installation on DIN rail. They are fanless, making them maintenance-free, and have an IP30 protection class.

The switches are available in four variants. ETHERLINE ACCESS M05T and M08T are managed switches with the option of configuration and five or eight RJ45 points. With the help of ring redundancy protocols, the managed switches ensure highly available networks. The ETHERLINE ACCESS U05T and U08T are unmanaged switches.

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EMBEDDED COMPUTER FOR SUBSTATIONS

Crystal Group Inc. has expanded its Rugged Embedded (RE) product line with the RE1012 Rugged Embedded Computer. The RE1012 is engineered with the latest commercial off-the-shelf (COTS) technologies, including Intel chipsets and processors, stabilised in a compact, rugged enclosure to provide robust compute power over a long operational life in extreme environments.

The RE1012 combines a six-core Intel Xeon D-1528 processor, up to 128 GB of ECC DDR4 RAM, two internal 2.5" SATA solid-state drive (SSD) bays and one internal m.2 SSD bay, as well as flexible I/O in a rugged package measuring 6.1 x 40.5 x 28 cm and weighing 3.4 kg.

Its fanless design employs passively cooled heat-pipe technology and has no moving parts, reducing noise and maintenance. The RE1012 can be panel or rack mounted and comes with a variety of power options for AC and DC inputs.

The RE1012 is designed and tested with remote electrical substations in mind. Surge protection is built in and it is virtually maintenance-free in harsh conditions including temperature extremes, high shock and vibration, and elements such as humidity, high altitudes, salt spray and dust.

The RE1012 is designed and tested to meet or exceed IEC-61850, and IEEE 1613 standards, and comply with Export Control Classification Number (ECCN) 5A992.

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PRESSURE RELIEF DEVICE MONITORING

HOW TO DETECT RELEASES, LEAKING AND FUGITIVE EMISSIONS – PART 2

How to comply with environmental regulations and detect PRD malfunctions while minimising costs and cutting operating expenses.

As discussed in Part 1 of this article, pressure relief devices (PRDs) become one of the last lines of defence in keeping process pressure within the limits tolerated by vessels, pipes and valves. PRDs can be pressure relief valves (PRVs), pressure safety valves (PSVs) or rupture discs (RD). They activate when the pressure gets too close to the maximum allowable working pressure of the vessel or process component. As per regulations, all PRDs must be mechanically powered by the process itself, so they do not require external power or intervention to function.

There are various faults that can occur with PRDs that can go undetected if they are not monitored properly. For example:

- PRVs and PSVs can stick open or chatter around their setpoint, releasing fugitive emissions.
- Valves can be damaged by deposits and corrosion, causing them to be ineffective or stick open.
- Rupture discs, often installed upstream of a PRV or PSV to prevent corrosion, can have pinholes form over time, resulting in a pressure equalisation on each side of the disc, preventing the disc from rupturing when it should.

The effective monitoring of PRDs is therefore necessary to:

- detect when over-pressure releases occur
- detect faults that may occur with PRDs to ensure they are fixed.



Regulations

The requirements for refineries, chemical plants and other industries are similar worldwide, with the main difference being the tolerated amounts for each type of pollutant released. The more stringent rules can be generalised with three simple requirements:

1. Provide indication and location where a PRD event occurs through electronic monitoring.
2. Measure the time and duration of the PRD event for recording and reporting.
3. Notify the operator of the event so corrective action can occur.

Also, it is expected that the flare operates at all times when emissions may be vented to them, so quick identification of a PRD release is imperative.

Several industries are subject to tight regulations, going so far as to issue detailed requirements for specific units in a plant, such as:

1. More stringent operating requirements for flare control to ensure good combustion. This is achieved by such measurements as:
 - Measuring and monitoring the flow of waste gas going to the flare.
 - Measuring and monitoring the content of the waste gas going to the flare.
 - Measuring and monitoring any air or steam added into the flare.
2. Emission control requirements for storage tanks, flares and delayed coking units at petroleum refineries.
3. Pollutant monitoring around the plant fence line as a development in practices for managing emissions of toxic pollutants from fugitive sources.
4. Elimination of exemptions during periods of start-up, shutdown and malfunction.

Most importantly, bypasses and discharges through PRDs are considered a violation of the law in many countries, requiring plants to monitor discharges of individual PRDs.

Monitoring PRDs

Historically, PRDs have been difficult to monitor because they are simple mechanical devices by design. Monitoring methods typically include manual inspection of telltale signs. For example, on PRDs releasing to the atmosphere, wind socks are often used to monitor releases.

In order to monitor with this method, it is common to use process instrumentation to observe pressure peaks and valleys around the pressure limit, temperature downstream and flow in the discharge header. However, this method cannot be used in enclosed systems. Plants monitor PRDs by observing process pressure, but when the pressure is close to the operating limit, the peaks and valleys make it difficult to determine when the PRD is actually opened or closed.

Unfortunately, these types of measurements are susceptible to false positives and inaccuracies and provide no insight into the health and status of the individual PRDs. Measuring flow in the discharge header does not show which PRD or PRDs were activated. Observing changes in the flare flame is also inaccurate and does not show which unit and which PRV caused the release.

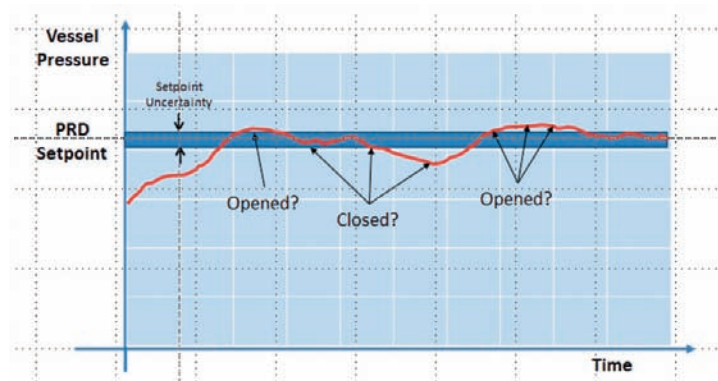


Figure 1: Inaccurate PRD monitoring by monitoring pressure variations.

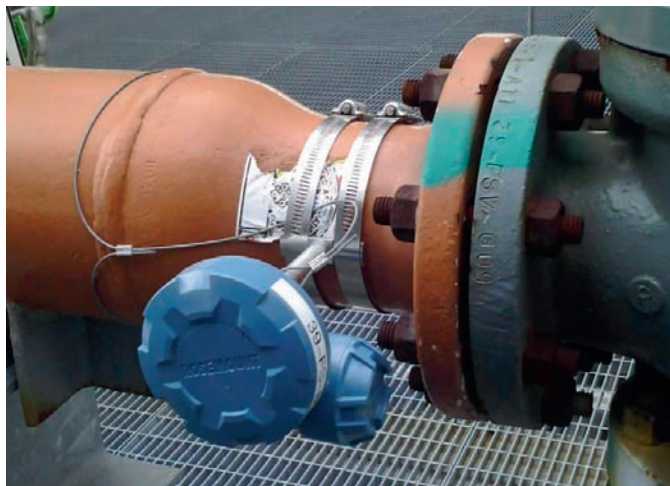


Figure 2: Wireless acoustic transmitter clamped to a pipe.

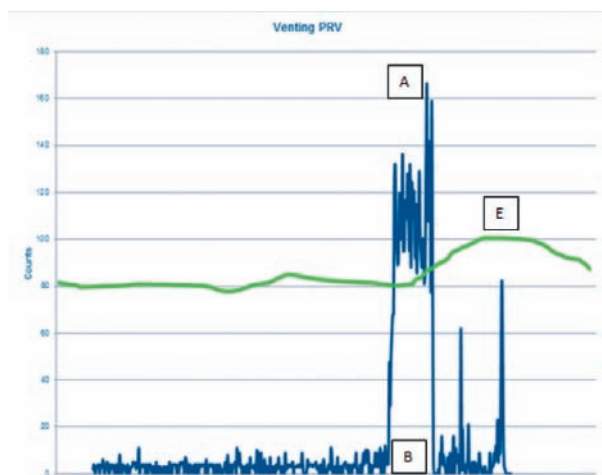


Figure 3: PRD discharge followed by temperature change.

A significant part of the difficulty when designing and installing a comprehensive monitoring system is that a typical plant will have several different PRD makes, models, sizes and operating pressures from various vendors. This can make it difficult to design a standardised monitoring system. The introduction of additional pressure, flow or temperature measurements in an existing plant also disrupts plant operation and the cost of laying new cables can be very high.

An effective way to monitor PRD activation and leakage

A very reliable, effective and economic way to monitor PRDs is to use wireless acoustic transmitters.

Process fluid flowing through valves and orifices generates acoustic waves in a wide and complex range of frequencies and magnitudes. A majority of the acoustic energy is in the ultrasound range, but some is also in the human audible range. Acoustic transmitters are able to detect ultrasound acoustic waves in the pipe wall as well as its temperature. These devices are wireless, small, lightweight and non-intrusive, so they do not require any change in plant installation. They can be easily clamped on the exhaust pipe, as shown in Figure 2.

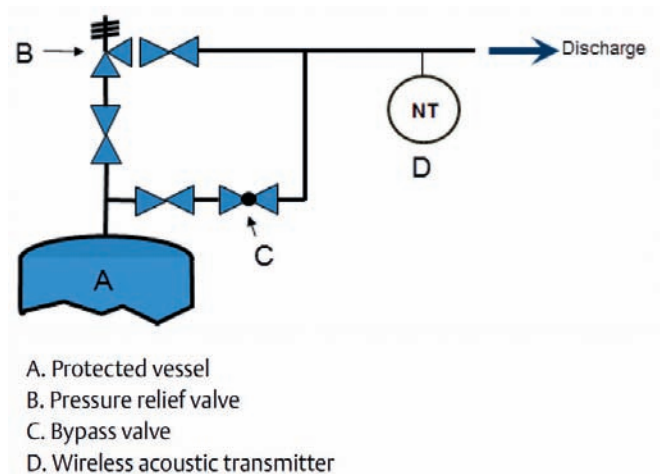


Figure 4: A wireless acoustic transmitter should be installed downstream, close to the valve.

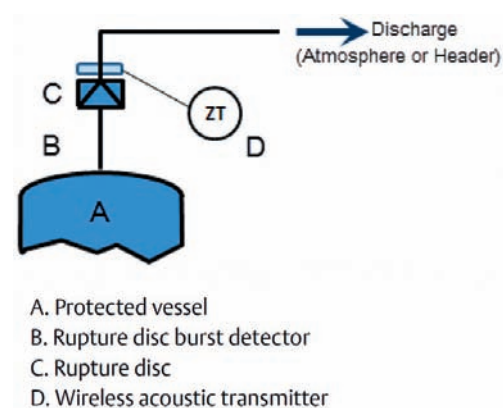


Figure 5: Rupture disc monitoring with burst detector and wireless discrete transmitter.

PRD operating condition can be determined by the following (Figure 3):

1. A noise level increase indicates that the PRD has been activated.
2. Noise level returning to the previous level indicates that the PRD is no longer discharging.
3. Noise level returning to a level above the previous level indicates leakage due to the valve not closing completely.
4. Noise level changing continuously indicates that the valve may be simmering or chattering.
5. Temperature changes may be used as an additional indication to validate a release.

Figure 3 illustrates the flow discharge followed by a temperature change.

Relief valve monitoring

Acoustic wireless transmitters should be installed downstream of the relief valve (RV), as close as possible to the valve. The wireless acoustic transmitter installed as indicated in Figure 4 monitors not only discharges or leakages of the relief valve, but can also monitor flow through the bypass valve.

Sometimes the wireless acoustic transmitter can measure noise originating in other parts of the process. If the background noise

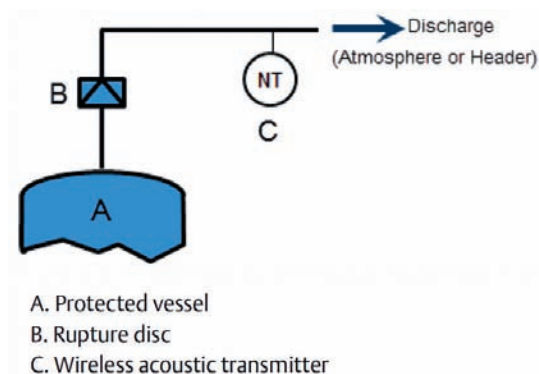


Figure 6: Rupture disc monitoring with an acoustic wireless transmitter.

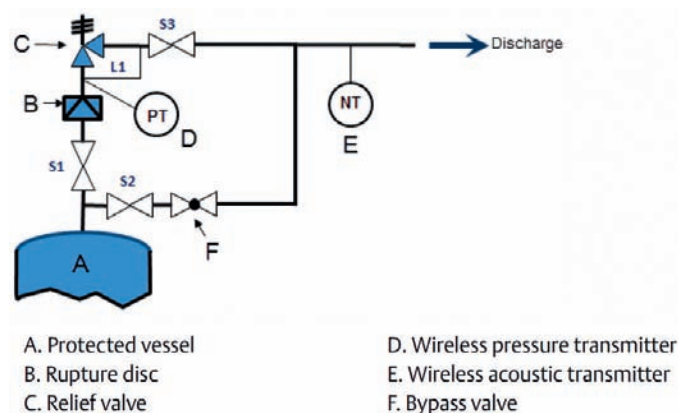


Figure 7: Monitoring a combination of relief valves with rupture discs.

varies too much, it may be difficult to determine when there is a discharge. In this case, it may be necessary to install a second acoustic transmitter downstream or upstream of the first one to measure the background noise and subtract its signal value from the signal being measured by the PRD monitoring transmitter. The calculation is done in the host system.

Rupture disc monitoring

Some types of rupture discs are equipped with a burst detector that generates a discrete signal indicating disc rupture. There are also devices that can be installed on the rupture disc surface that can detect when the disc ruptures and indicate the event through a discrete signal. The discrete signal is usually wired back to a supervisory system or safety system. A wireless discrete transmitter can be used to transmit the discrete signal, eliminating costly and troublesome wiring, as indicated in Figure 5.

A more effective way to monitor rupture discs

Rupture discs can be better monitored with the use of a wireless acoustic transmitter, as indicated in Figure 6. The transmitter can detect when the disc ruptures and the duration of the discharge, as it does for relief valves, but it may also detect even small leaks caused by pinholes.

Monitoring a combination of relief valves and rupture discs

As discussed before, relief valves must be isolated from harsh process conditions by using rupture discs. In normal operation, the relief valve is not in contact with corrosive, gumming or hot process fluids. If the vessel pressure reaches unsafe values, the rupture disc bursts, followed by the RV opening.

If the rupture disc acquires a pinhole leak, the pressure between the two sides of the rupture disc will be the same, so the disc will not burst. Vent lines may be installed to release eventual leakage, but to be safe, standards and regulations ask for remote monitoring of the pressure in that space between the RD and the PRV.

A wireless pressure transmitter can provide accurate and reliable pressure measurement; however, monitoring the pressure

between the RD and an RV is not sufficient to reliably determine when the RV has opened or closed, so still needs to be used in conjunction with a wireless acoustic transmitter downstream of the RV, as shown in Figure 7.

It should be noted that the rupture disc does not need to be replaced immediately after bursting, because the wireless acoustic transmitter is still monitoring pressure releases. This allows maintenance personnel to replace or maintain the equipment at the most convenient time, without having to slow or shut down the process.

Conclusion

Pressure relief device monitoring is necessary for environmental protection compliance and can help to avoid expensive fines, as well as possible process unit or plant shutdowns. Monitoring also prevents waste of costly material and energy, avoids bad publicity and helps improve plant personnel and neighbouring communities' health. Wireless acoustic, pressure and discrete transmitters are a very effective, reliable, and economic way to have a compliant and better performing process.

	Traditional method	Wireless solution
Total project cost (USD, thousands)	\$3,520	\$464 – \$1,088
Total cost per PRD (USD, thousands)	\$18	\$2.3 – \$5.4
Savings	N/A	69% – 87%
Field installation	Intrusive	Non-intrusive
Cabling and trenches required	Yes	No
Technology	Wired	Wireless

Table 1: Total cost of implementation for 200 PRDs. Total costs include monitoring of the wireless system, tamper-proof secure data and engineered services. Cost range dependent on application: PRV only or PRV with rupture disc monitoring.

Emerson Automation Solutions

www.emersonprocess.com.au



Safe tool changes for catalytic converter machines

Large engines produce a lot of exhaust gas. The exhaust gas cleaning systems of a truck are thus sized accordingly. Up to six catalytic converter systems clean the exhaust gases of a large truck engine. A catalytic converter for a car and for a truck consists of three main units: a monolithic ceramic block (mono), a fibre mat wrapped around the monoblock and an outer metal pipe. The ceramic block has a honeycomb structure and the honeycombs are coated with a catalytically active precious metal. Under the microscope, this so-called wash coat can be seen to be extremely rough. As a result, the coating has a surface area of up to 100 m²/g. The catalysis of carbon monoxide, which converts hydrocarbons and nitrous oxides into carbon dioxide, water and nitrogen, takes place on this surface.

The fibre mat ensures correct positioning inside the outer metal pipe and must have precisely the correct density so that the exhaust gas does not flow past the monoblock. The outer metal pipe provides the process connection to the engine and the downstream exhaust gas line of the vehicle. Major vehicle manufacturers mount these three basic elements and other components themselves, depending on the type of catalytic converter, in their vehicle plants. Monoblocks, fibre mats and pipes are supplied.

There are two different processes used for mounting catalytic converters: hard stuffing and soft stuffing. With hard stuffing, a monoblock with a fibre mat is inserted under pressure into a pipe that is enlarged beforehand to the required dimension. With soft stuffing, the monoblock with a fibre mat is loosely inserted into an outer casing and then compressed (or shrunk) to the required dimension.

With both processes, the mounting of catalytic converters in an automated manufacturing cell is highly complex. As a result, many well-known vehicle manufacturers now turn to Kirschenhofer Maschinen in southern Germany. The special machine manufacturer specialises in these kinds of mounting machines and has acquired a considerable amount of

know-how. With 25 employees, the company produces machines that are technological leaders in their sector.

One major truck manufacturer produces up to 60 different types of catalytic converter in its mounting plant. These catalytic converters vary in size, with round, oval or polygon cross-sections, and are also manufactured using the hard stuffing or soft stuffing process. The plant has to offer a high degree of flexibility in order to handle all the variants without any refit times. The batch of pipes, fibre mats and monoblocks that were fitted in each catalytic converter must also still be traceable after 10 years in case of recalls.

Production faults are prevented and detected by the machine during the manufacturing process. The monoblocks, for example, are checked for cracks and damage at the edges and any faulty parts are removed. With the hard stuffing process, the pipes have to be expanded to the required dimensions and, depending on the geometry of the subsequent catalytic converter, the different tools required are clamped into a machine and mostly changed after a production batch. This takes place several times a day, with batches of between 200 and 1000 catalytic converters and a production rate of around one catalytic converter per minute.

"The customer has 20 different tools in use. The ID number of the particular tool is stored on the RFID tag. The machine uses the ID number to check whether the correct tool was inserted and only then enables the stretching of the pipe," explained Thomas Schön, programmer at Kirschenhofer. With a force of between 30 to 60 tons exerted by the machine, the use of the wrong tool would cause enormous damage and major production failure.

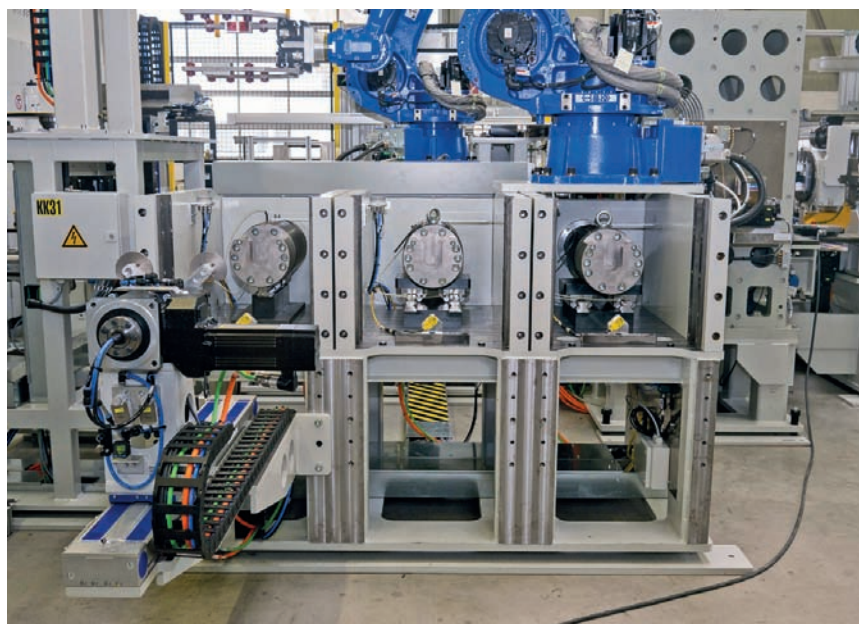
The tool identification process was implemented with Turck's RFID BL ident system. The tools are fitted with TW-R30-M-K2 tags, which are embedded in the metal. Turck's compact TN-Q14 HF read/write heads are fitted at the tool holders.

"We chose Turck's RFID readers due to their compact design," said Craig Crail, head of the electrical department at Kirschenhofer. The Q14 is only 14 mm high and offers a maximum read/write distance of up to 72 mm. Although the range is shorter in the metal environment, it is still enough to protect the read/write head from colliding with the tool.

Another machine type from Kirschenhofer, of which more than 10 are already in use by a major German car manufacturer, also checks the pipe diameter after the stretching process and compares the value with the tolerance values stored on the tag. The benefit of this additional option is that the machine can detect during stretching any wear on the tool, material faults or operating errors.

A longer and more detailed version of this article can be read online at: <http://bit.ly/2EZB3SS>

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I4.0: HOW DO WE CREATE SMART FACTORIES?

Over the years, global manufacturing industries have been propelled by four disruptions: the usage of mechanisation as well as water and steam powered machines during the 18th century (Industry 1.0). The mass production based on the division of labour and powered by electrical energy (Industry 2.0), the adoption of electronics (PLC controllers) and IT for further automation of executing processes (Industry 3.0). Now we see the emergence of cyber-physical systems, the Internet of Things, cloud computing and cognitive computing (Industry 4.0).

Industry 4.0 is the full digitisation of production and logistics — right down to machines that control themselves and optimise their own work steps. Intelligent sensors are a crucial element of this vision. This is why we are already laying the foundations for dynamic and real-time optimised processes for the future. As providers of data to enable 4.0, sensors are an essential technology in smart factories. As sensor experts, we understand the responsibility we bear: our products, systems and services are consistently designed for reliability, including in virtual networks. We enable our customers to collect targeted, application-specific data by individually configuring our sensors for optimised and efficient production processes. The seamless networking of individual production steps means that you can combine these steps in any way you require, with full traceability. You can create tailored products on request, and all production steps become fully traceable in real time — efficiency, flexibility and transparency are the hallmarks of the smart factory.

Within Australia, we face many challenges in the manufacturing sector, and these challenges continue as we compete in the global arena. In today's market, consumers demand high-quality products, individualisation, seamless customer experience and on-time delivery. To be able to capture that market requirement we need to develop the backend infrastructure to produce and deliver our products in real time within a similar price range to the traditional mass produced product. Taking on the I4.0 method-

ologies is the first step towards offering that competitive advantage now and in the future.

One of the biggest challenges is how we transition towards Industry 4.0. The answer is not that simple; it is rather a journey typically commencing with a digital strategy: what do we want to achieve from digitalisation? And at the same time, we see many organisations struggling to understand their complete supply chain from resource extraction all the way to point of sale. I met an organisation last year that had commenced the digital journey, and the biggest eye-opener for them was not understanding their complete supply chain. So they went back to basics, used flip charts and documented every step throughout their supply chain; they then applied lean thinking principles, and only after that did they go digital. The theory was that if you apply digitalisation to a broken thing you will have a digitalised broken thing.

The point is that if we Australians can channel our ingenuity and creativity towards Industry 4.0, the pay-offs will be impressive. The industry is overloaded as we undergo rapid and transformational technological change and so to capture the projected impact (I4.0) of \$10 trillion globally on GDP, it is imperative that we take action and not operate in isolation. We need to recognise the value of our scientists, researchers and out-of-the-box thinkers who are leading disruption of traditional business models with their work.



Jason Mair is the National Product Marketing Manager for SICK Australia/New Zealand. He has 25 years' experience working in manufacturing and sales, focusing on improving productivity and safety

through the introduction of advanced automation. He is also a current member of the SF041 safety committee developing the AS/NZS4024 safety series of standards for the Australian and New Zealand markets.



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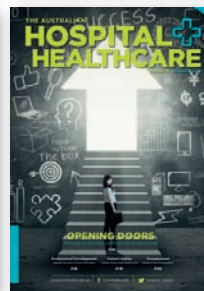
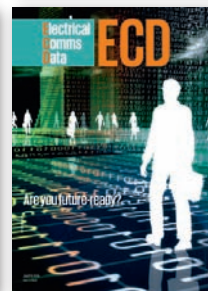
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